DOCUMENT RESUME

ED 051 179 SP 007 242

TITLE	K-12 Science Curriculum Guide.
INSTITUTION	Reading Community Schools, Ohio.
PUB DATE	68
NOTE	302p.
EDRS PRICE	EDRS Price MF-$0.65 HC-$13.16
DESCRIPTORS	Biology, Chemistry, Curriculum, *Curriculum Guides, Earth Science, *Elementary Grades, Elementary School Science, Grade 1, Grade 2, Grade 3, Grade 4, Grade 5, Grade 6, Grade 7, Grade 8, Grade 9, Grade 10, Grade 11, Grade 12, Intermediate Grades, *Kindergarten, Physics, *Science Curriculum, *Secondary Grades

ABSTRACT

GRADES OR AGES: K-12. SUBJECT MATTER: Science. ORGANIZATION AND PHYSICAL APPEARANCE: The guide is divided into three sections, one each for elementary grades, middle grades, and high school. The first two sections are further subdivided by grade level and the last section is subdivided by course. Sections are laid out in four columns across two pages. Column headings are concepts, teaching methods and learning activities, resources, and evaluation. The guide is mimeographed and loose-leaf bound with a soft cover. OBJECTIVES AND ACTIVITIES: General objectives are outlined in an introductory section. Suggested activities are correlated with specific scientific concepts and specific objectives. Activities include reading, laboratory experiments, lectures by outside experts, field trips, and independent projects. INSTRUCTIONAL MATERIALS: Materials needed for an activity are listed with the activity description. The lists include both print and audiovisual materials. Textbooks used in the middle grades are listed at the beginning of the section. STUDENT ASSESSMENT: Suggestions for evaluation accompany each group of activities correlated with a concept--usually teacher observation in the lower grades and teacher-developed and textbook quizzes and exams in the upper grades. (RT)

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K - 12 SCIENCE

Curriculum Guide

1968-1969

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FORWARD

The publication ofthis Curriculum Guide represents the culmination of a year of study. The final editorial work was carried out by six teams of teachers during the summer of 1968. These materials were prepared under the supervision of Mr. Ronald A. Hilvers, Director of Instruction.

Teachers are encouraged to refer constantly to this guide during planning sessions throughout the year. It should be understood that any resource material cannot be the final answer to instructional questions, but rather a tool to direct the thinking process of the teacher. Periodically this guide will be updated. In order to facilitate this process teachers should write in suggested changes, additions, or deletions in the spaces left for this purpose. Particular attention should be paid to sections of the guide which outline expected outcomes. By paying attention to these objectives, the teacher should be better able to design and evaluate an effective program for the children.

The Reading Community Schools
Reading, Ohio
September, 1968

SP007242

INTRODUCTION

If historians affix a descriptive label to the twentieth century, there are good chances that it will be "The Age of Science." Never before in history has science played so intimate a role in the daily life of man. Today science affects the manner of work, the media of communication and travel, the processing of foods, the development of natural resources, man's health and general well-being. In fact, science holds the key not only to how man will live but also to whether he will continue to live.

The science program in the Reading Community Schools is designed to help students learn to formulate scientific theories, to become aware of their own learning processes, and to be prepared to intelligently apply the principles of science to life situations. Its goal is to encourage the inquisitive child to become an inquiring adult - a self-confident, reasonable person who can and will investigate the world for his own satisfaction.

The topics of this guide extend from topics that occur in daily life to relatively advanced subjects of science.
In spite of the obvious limitations to any one guide, the meticulous care of the contributors has made possible the inclusion of a wide selection of unit topics.

PHILOSOPHY

The science program for The Reading Community Schools is planned to help in the total development of each child to the limits of his capabilities, allowing him many opportunities to express himself in the direction of his interests. The program is organized so as to help the pupil make consistant growth toward becoming the type of individual that can best adapt himself to the society in which he is living.

To make this possible the science program must be flexible. It must be forever changing if it is to meet the demands of the youth then participating. If it is to be kept "modern" everyone should accept the challenge of keeping-up, fostering a science program for the day and for the future, offering every opportunity for the students to become acquainted with "What's New."

Science is much more than a series of experiences outlined in any given textbook. The very nature of the subject dictates that there are concepts to be learned that are far more important to the proper development of the child than are the isolated facts to be memorized. Youth should be taught to evaluate what he experiences, what he reads, hears, sees, and does. Perhaps the greatest contribution to be made by studying science is the development of a way of thinking, a way of arriving at a solution to a problem. Teachers should take advantage of every opportunity to help children develop a scientific attitude. The individual will then be better qualified to evaluate, to make better choices, and to apply its principles intelligently to life situations. Through experiences in science a pupil learns to establish contact with God, the world, and life upon the earth.

OBJECTIVES

1. To provide children with those understandings of science which will help them to live in a world of change, able to accept change, as normal, discerning order and rhythm in the process of change.

2. To help the children gain some understanding of the scientific method of inquiry or investigation.

3. To maintain and intensify the natural curiosities of the child in his ever-expanding environment and also to help him to observe these objectively.

4. To develop a better understanding of the natural, physical world.

5. To encourage wide and intelligent use of sources of information as well as to acquaint the child with resource persons, community resources and various reference materials.

6. To provide children with those experiences which will help them to feel comfortable with the materials and vocabulary of science.

7. To learn more about the needs of all living things, including the needs of the human body.

8. To assist a child in identifying himself in a universe filled with a variety of living and non-living objects and an array of events and changes.

9. To help children get acquainted with those of times past and present who have contributed greatly to the field of science.

10. To consider subject matter primarily as a means to an end and not as something to be remembered.

11. To suggest and recommend science career opportunities to those indicating interest, desire and ability.

12. To develop appreciations for and attitudes about the environment.

SCIENCE CONCEPTS	Elementary						Middle			Secondary			
Year	K	1	2	3	4	5	6	7	8	9	10	11	12
Interpreting our Earth Through Energy Systems													
Force and Work			↔		↔		↔	↔	↔				↔
Forms of:													
Mechanical Energy							↔	↔	↔				↔
Flow of:													
Conduction							↔	↔	↔		↔		
Convection							↔	↔	↔		↔		
Radiation							↔	↔	↔		↔		
Solar Energy					↔		↔	↔	↔		↔		
The Sun				↔			↔	↔	↔		↔		
Introduction to Earth Science		↔	↔	↔	↔	↔	↔	↔	↔		↔		
Energy Systems of Planet Earth													
Kepler's Laws							↔	↔	↔				↔
Rotation of Earth							↔	↔	↔		↔		↔
Velocity							↔	↔	↔				↔
Gravity							↔	↔	↔				↔
Electromagnetic Radiation							↔	↔	↔		↔		↔
Structures of the Atmosphere							↔	↔	↔		↔		↔
Sphere and Circles							↔	↔	↔		↔		
Latitude Longitude							↔	↔	↔		↔		
Magnetism			↔				↔	↔	↔		↔		↔
Solar System							↔	↔	↔		↔		↔
Energy Systems of Atmosphere and Oceans													
Weather	↔	↔	↔	↔	↔	↔	↔	↔	↔		↔		
Temperature		↔	↔	↔	↔	↔	↔	↔	↔		↔		↔
Humidity							↔	↔	↔		↔		
Air Masses				↔			↔	↔	↔		↔		
Ocean							↔	↔	↔		↔		

SCIENCE CONCEPTS - Cont'd Year

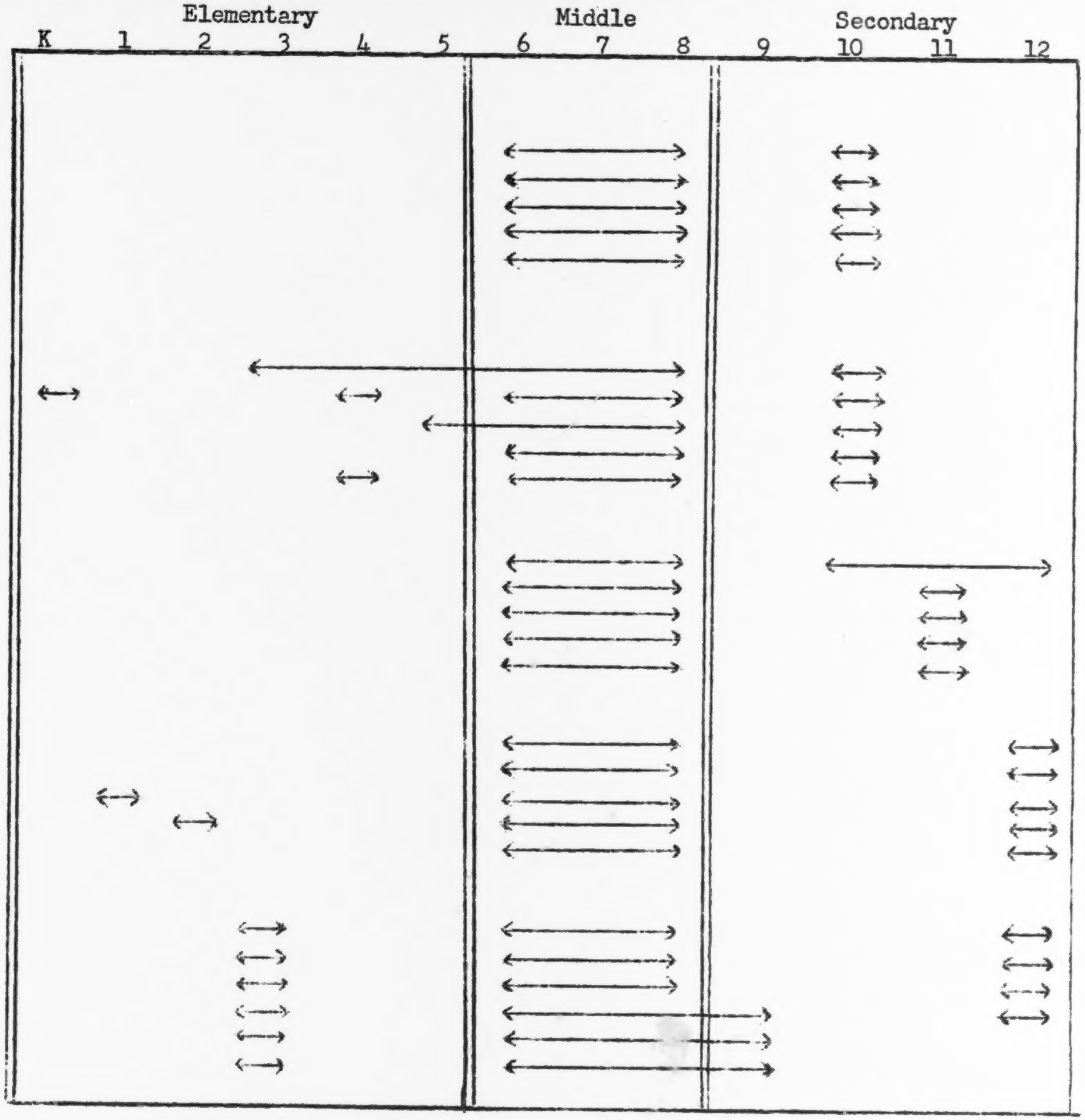
Energy Exchanges in the Land Surface Zones
Weathering
Flowing Water
Glaciers
Tides
Wind

Energy Systems in the Solid Earth
Volcanoes
Igneous Rock
Earthquakes
Oceanography
Geologic Eras

The Elements of Chemistry
Atom
Periodic Table
Metals and Non-Metals
Bonding
Compounds

Machines and Energy
Force
Work
Machines
Magnetism
Electricity

The Biophysics of Sound
Vibration
Wave Motion
Sound Wave
Sound from Voice
Animal Sounds
The Ear



SCIENCE CONCEPTS -Cont'd

The Energy of Light
Spectrum
Photosynthesis

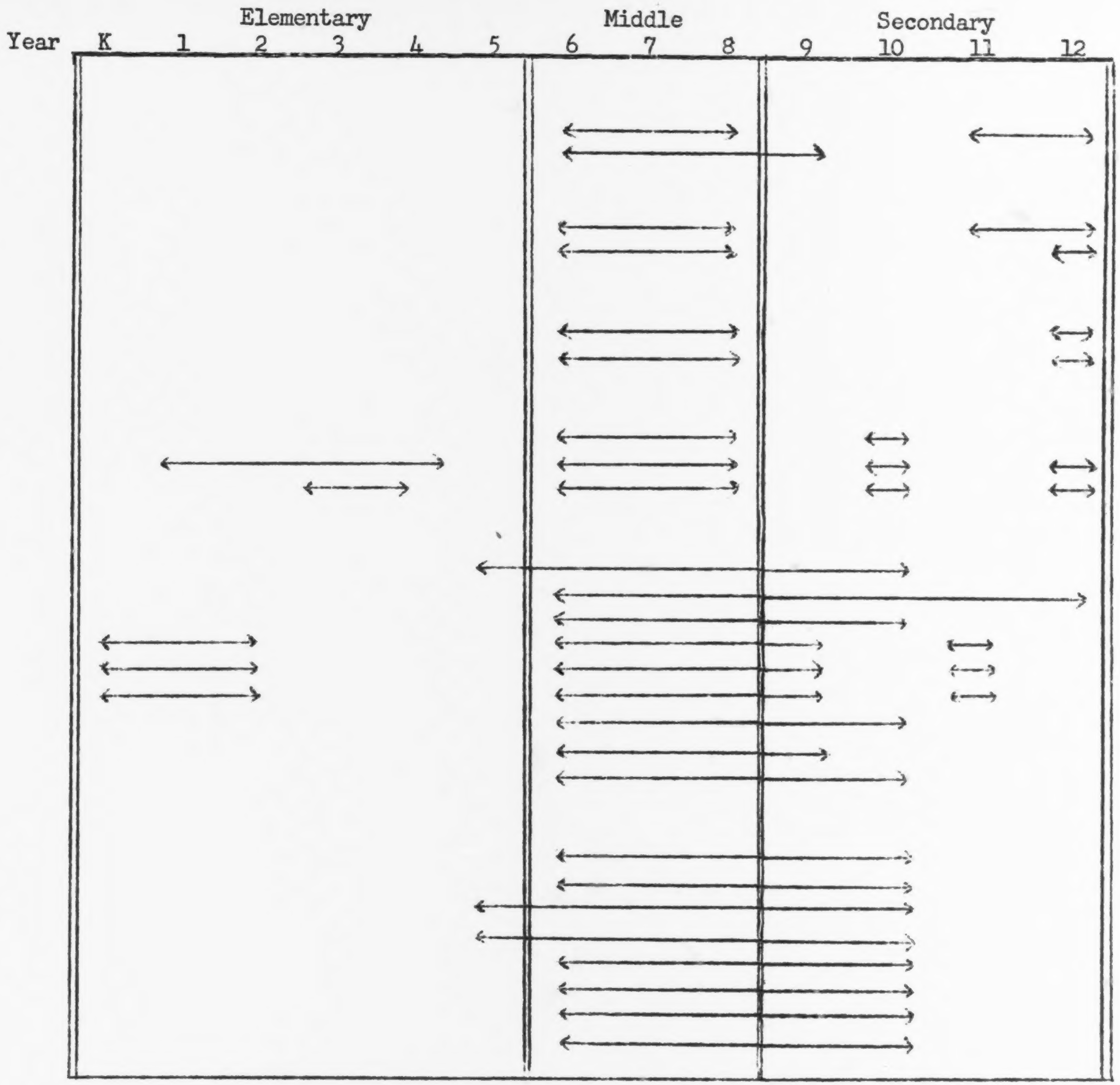
The Energy of The Atom
Radio Activity
Reactors and Accelerators

Electronics
Radio
Computer

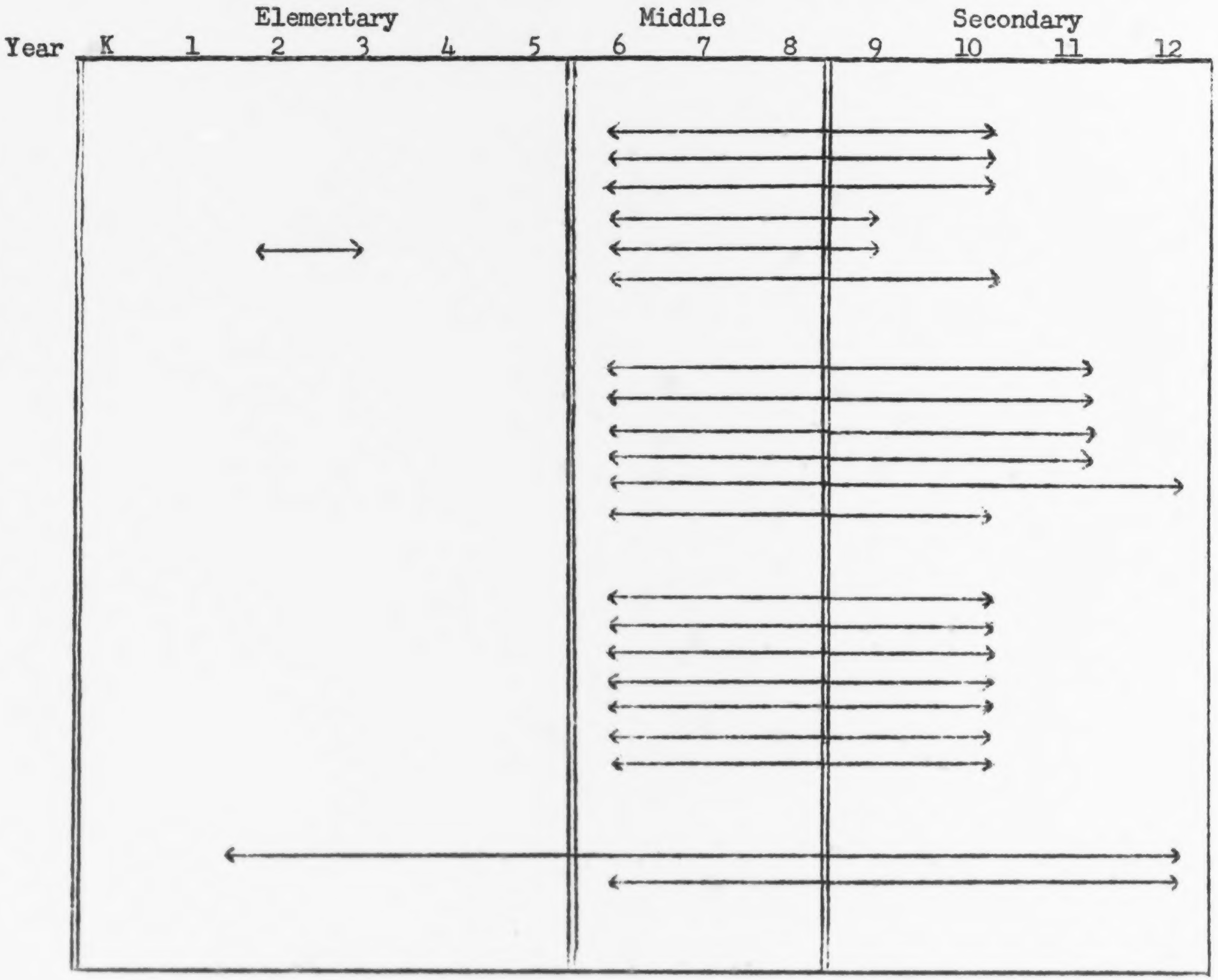
From Atmosphere to Space
Planes
Rockets
Satellites

Life in a Physical World
Nervous System
Properties of Matter
Protoplasm
Carbohydrates
Fats
Proteins
Cell Structure
One-Celled Animals
Kinds of Tissues

Living Things
Classification
Protozoans
Bacteria
Algae
Non-Vascular Plants
Vascular Plants
Invertebrates
Vertebrates



SCIENCE CONCEPTS - Cont'd



From Life to Life
Heredity
DNA
Cell Division
The Flower
Fruits and Seeds
Cleavage

Chemistry of Living Things
Solutions
Solvents
Body Temperature
Colloids
Diffusion
Digestive System

The Living Biosphere
The Biosphere
Parasites
Ecology
Cycles
Habitats
Food Chain
Symbiosis

Biology in Space
Concept of Space
Radiation

READING COMMUNITY SCHOOLS

CURRICULUM GUIDE

SCIENCE

ELEMENTARY

Concepts	A) Teaching Methods B) Learning Activities
Kindergarten Science	
Spaces and Places 1. We are nearer to some things than to others. 2. We are farther from some things than from others. 3. Moving faster gets us there sooner. 4. Up and down depends on where you are.	A) Inquiry, exploration, discovery, experiences, observing, predicting, comparing. B) Direct the children's thinking by orienting them in the room to one object such as the door. Example: "Which table is nearest to the door? Which is farthest?" Have races between two children. One child will walk-one run. Walk in different ways from one place to the other. What is in *front* of you? (Glance behind them.) What is in *back* of you? What is in the *front* of the room? What is in the *back*? Make straight lines using three or four children. Discuss what is *high* in the room. What is *low*.
What's Alive 1. There are many kinds of living things. 2. Animals move, eat, breathe, grow, and protect themselves. 3. Plants are living things . 4. Living things change as the seasons change.	Take a walk around the schoolground. Name the things they see that are alive. Have a turtle, fish and growing plants for the children to observe. What do they need? Are you alive? What do you need? Take the same walk. Can you find more things that are alive? Are insects alive?

Resources
A) Printed
B) Audio Visual
C) People
D) Places

A) Let's Find Out, Cadmus
   Fall is Here
   Winter is Here
   Spring is Here
   Summer is Here
   Bird's Nest, Turtles, Fish
   Wonders of Nature
   Up Above and Down Below
   My Five Senses
   My Hands
   Now I Know
   The Indoor Noisy Book
   All Sizes of Noisy Pets
   Large Zoo Animals
B) Pictures of Living Things
   Pictures of Things that Show the Seasons.
   Science and Wondering Charts - Scott-Forsemen
   Filmstrips:
      Tubby Turtle
      Copy Kitten
      Animals
      Animal Babies
      Animals of Sea and Shore
      Birds
      Autumn is Here
      Winter is Here
      Spring is Here
      Summer is Here
      Mr. and Mrs. Robin and Their Springtime Story
      On the Farm with Tom and Susan
   Use a magnifying glass as often as possible.
C) A parent might bring a pet and tell how to care for it.
D) Field Trips:
      To the zoo
      To a farm
      To Sharon Woods

Evaluation
A) Expected Outcome
B) Testing Program

A) Are the children more aware of the things around them?
   Can they draw some of them on paper in form of pictures of what they see?
   Do they collect things such as rocks, shells, etc.?
B) Teacher evaluation through questions, showing of interest, participation in activities.

Concepts	A) Teaching Methods B) Learning Activities
Discovering Our Senses 1. We find out about the world around us by seeing, hearing, smelling, touching and tasting. 2. Seeing is one way of finding out; we see with our eyes. 3. Hearing is one way of finding out; we hear with our ears. 4. Tasting is one way of finding out; we taste with our tongues. 5. Smelling is one way of finding out; we smell with our noses. 6. Touching is one way of finding out; we touch and feel with our fingers and our skin. 7. Lifting is one way of finding out; we lift with muscles in our arms.	B) Have several familiar things in a bag. Blindfold a child-have him take something from the bag, let him tell what he thinks it is. Help him use words such as soft, hard, bumpy, heavy, etc. Have some "smell" jars for the children to guess what they smell. Have a box of things to feel, such as fur, sandpaper, rocks, cotton, etc. Have some sounds behind a screen. Have the children cover their ears. Can they hear? See if they can recognize some familiar sounds. Blindfold a child and give him something familiar to eat such as candy, raisins, apple, etc. Can he guess what it is? Have three boxes, fill one with stones, one with cotton, one with a book. Which is heavier?,lighter?
Sounds We Hear 1. There are many different sounds around us. 2. We can often tell, without looking, what makes a sound. 3. Different sounds are made in different ways.	What sounds do we hear in our classroom? Go on a "sound hunt". What do you hear at home? Are the sounds loud or soft? Are the sounds high or low?
Light and Dark 1. Light comes from the sun, moon, electric lights. 2. When light is turned off or blocked, it gets darker. 3. We can make shadows by blocking some of the light with an object.	What things give us light? How does the light help us? Make shadows with a variety of things. Notice your shadow at different times of the day.

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Evaluation
A) Expected Outcome
B) Testing Program

Concepts	A) Teaching Methods B) Learning Activities
Weather 1. The sun heats and lights the earth. 2. The sun helps to dry wet objects. 3. Shade is formed where sunlight is blocked. 4. The thermometer shows the temperature of the air around us.	B) How does the sun feel? Where do we play when it is hot? What happens to the sun on a cloudy day? Where does the water go when you hang out wet clothes? Wash the doll clothes and find out. Have a large thermometer and show how it moves up and down. How can we "keep cool" on a hot day?
First Year Science	
Animals Question: In what ways are animals different? 1. Animals are different in many ways. 2. Animals differ in size. 3. Animals move in different ways. 4. Animals have different coverings. Question: How do animals move and eat? 1. Animals move in different ways. 2. All animals need food. 3. Different animals need different kinds of food. Question: Where do animals live? 1. Animals live in many different places. 2. Animals make many different kinds of homes. 3. Animals are protected by their homes.	A) Reading, discussing, observing, experimenting, investigating. B) Animal Pictures - either teacher collected or series bought. Be sure to have a variety in size of the animals. Act out how animals move. Have a dog, cat, or rabbit in the classroom. Discuss its home, covering, food. Write an experience chart about it. Draw pictures of it. Bulletin board of different animals and their homes. Make an aquarium. Make animals out of clay. Teacher may read animal stories at Story Time. Learn a poem about an animal. Learn animal songs. This unit should provide the child time to do a lot of talking - telling about animals they know, etc. What "story-book animals" can we find in the zoo? Are birds animals? Take a walk to look for birds. How do animals protect themselves? What sounds do animals make?

Resources
A) Printed
B) Audio Visual
C) People
D) Places

A) Album of North American Animals, Dougale
Living Things
Let's Get Turtles
Young Scientist Takes a Ride
Text: Looking Into Science
Jacobsen, et. al.
American Book Company.
Scholastic Weekly "News Ranger"

B) Filmstrips:
- Where Animals Come From
- Why Animals Need Heat, Food, and Air
- How Animals Protect Themselves
- Different Kinds of Animals
- Animal Babies
- Animals of Sea and Shore
- Fall is Here

D) Field Trips:
- Cincinnati Zoo
- Pet store
- Farm
- Sharon Woods
- Natural History Museum
- Hatchery

Evaluation
A) Expected Outcome
B) Testing Program

A) Children show familiarity with a great many different kinds of animals and they live in many different environments.
Do the children understand the need for animals to have a good home and good food.

B) Evaluation by the teacher by oral questions and discussion.

Concepts	A) Teaching Methods B) Learning Activities
Rocks Question: How are rocks different? 1. Rocks differ in many ways. 2. We group together rocks that are alike. 3. Most systems of classification in science are based on the physical characteristics, such as color and hardness, of the things to be classified. Question: How are rocks made and changed? 1. Some rocks are formed under water. 2. Some rocks are formed as hot, melted rock cools. 3. Some rocks are changed by pushes in the earth.	A) Observing, experimenting, talking, feeling, investigating. B) Collect rocks. Classify them as to color and hardness. Be sure to have some fossil rocks. Make a collection of other objects and observe size, shape, color, and texture. Test the hardness of the rocks with a penny, piece of glass or a knife. Think about how rocks are used. Experiment: Melt chocolate and pour out and let cool. This is like molten rock. Observe as it cools. Make sand by using sandpaper on soft rocks. Examine the sand with a magnifying glass.
Day and Night Question: How do shadows change? 1. Shadows change in direction and length during a day. 2. Shadows point in a direction opposite to that of the sun. 3. When the sun is low in the sky, the shadows are long. When the sun is high in the sky, shadows are short. Question: What makes day and night? 1. When our side of the earth is toward the sun, we have day. When our side of the earth is away from the sun, we have night. 2. The earth turns around once each day.	A) Reading, discussing, observing. B) Learn the directions -- north, east, south and west. Put up signs in the room. Go outdoors in the morning, again at noon and late in the afternoon, to observe shadow.. Play a game by letting the children go outdoors and try to step on another's shadow. They are out of the game if someone steps on their shadow. Experiment - Use two balls the same size. Let a child take it to the far end of the playground. How does it look? Compare the moon and sun to these balls. You can use the third ball for the stars and have that ball farther. Use a globe and a flash light to demonstrate why we have day a and night and why the sun, moon, and stars seem to move across the sky.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
A) First Book of Rocks Rocks and Their Stories, Fenton D) Field Trip: A trip to a place where there are lots of rocks. Write an experience chart about the trip.	A) Are the children interested in in rocks? Are the children able to differentiate between the rocks? Are the children gaining skill in making observations? B) Oral questions by the teacher
A) How the Sun Helps Us, Blough Sun, Moon, and Stars, Freeman What the Moon is Like The Sun, Branley Sun: Star Number One Moon B) Film Strips: What Do We See in the Sky Our Sky, Our Moon Night and Day	A) The child should become more aware of the day and night sky. The child should acquire a questioning attitude. The child should be able to draw the Big Dipper. B) Teacher evaluation through questions and discussion.

Concepts	A) Teaching Methods B) Learning Activities
Question: What do you see in the sky? 1. The sun shines all the time. Sometimes we cannot see it because of the clouds. 2. Big things that are far away seem small. 3. The sun, moon, and stars seem to move across the sky because the earth is turning. 4. The moon looks as big as the sun because it is much closer to us. 5. There are stars in the sky in the daytime, but we cannot see them because the sun is so bright.	Experiment-Make a sundial out of cardboard. Use it to tell time. Keep a daily record of the daytime sky. You could draw clouds or the sun on the calendar or write a weather chart.
Fire and Temperature Question: What is fire? 1. We get heat and light from fire. 2. Fuel and oxygen are needed for burning. 3. Fires can be put out by removing the fuel or the oxygen. 4. Oxygen can combine very slowly with substances such as iron. In this case, there is no flame. Question: What is temperature? 1. Temperature is the degree of hotness or coldness. 2. Temperature is measured with a thermometer.	A) Reading aloud, discussing, observing. B) Demonstrate with a candle that fire needs fuel and air. Demonstrate with a gas stove (school cafeteria) that you cannot see gas but it burns. Its value to us. Put a burning candle out by using sand. Let some iron nails stay outside a few days - note the rest. Look at it under a magnifying glass. Have a thermometer - large enough for the children to be able to see and understand it. Learn to read it. Keep a temperature chart for a week.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) My Little Book of Fire Engines
We Read About Fire and How it is Used
B) Filmstrips:
Story of Fire - McGraw Hill
Heat - Filmstrip House
C) Chief Elmer Seibel, Reading Fire Department
D) Field Trip:
Fire station

A) Expected Outcome
Evaluation B) Testing Program

A) Do the children show by their questions and comments an awareness of the importance of fire in their daily lives?
Do the children show that they understand the fact that fire needs air and fuel?
Do the children understand the why of a fire drill?
Do the children understand the need of safety around fire?
B) Teacher evaluation through oral discussion.

Concepts	A) Teaching Methods B) Learning Activities
Machines Question: What are machines? 1. Machines help us to do different kinds of jobs. 2. A lever helps us to lift things. 3. We can lift heavier things with a long lever than with a short one. Question: What machine helps to move things? 1. A ramp is a machine that can be used to move things up and down. Question: What machines work together? 1. Several machines can be used together. 2. Wheels help us to move things. 3. Wheels are made up of many levers. 4. Wheels can be used as pulleys to lift things. Question: What machine moves through something? 1. A wedge is a machine used to split things. 2. A wedge is two ramps back to back.	A) Reading, discussing, observing. B) Bulletin board of Machines We Use. Children could cut these from magazines. Experiment with a balance board. Be sure to use the word equal and that students know what it means. Experiment trying to use a lever. Let the children use a nutcracker. In cracking a nut, how did they do it? Experiment with ramps and chutes using toy cars, chalk erasers, books, etc. Play a game: Tie a string between two chairs like a pulley clothes line. Send messages by clipping a piece of paper and pulling it along the line. The message may tell the child to do something. Example: Sing a song. Take a walk around the block and find all the ways wheels help us. Make some wheeled vehicles using boxes or milk cartons and card board wheels put on with paper fasteners.
Rockets Question: Why does a rocket move? 1. For every action there is an equal and opposite reaction. 2. When the air in a balloon moves in one direction, the balloon tends to move in the opposite direction. 3. When something moves out one end of a rocket, the rocket tends to move in the other direction.	A) Reading, discussing, observing. B) Experiment with balloons by blowing them up and letting the air come out. Be sure the children know why they are doing it — that it is a learning experience. Have the children use the countdown procedure. Bring out the idea that a rocket must take fuel and oxygen with it while a jet only takes fuel.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
A) Machines What Makes the Wheels Go Round, Huey How Things Work Machines at Work, House B) Filmstrips: How Wheels Help Us How Levers Help Us How Ramps and Screws Help Us How Wedges Help Us D) Field Trips: To a construction site to view cranes, shovels, wheelbarrows, etc. To a factory where they could view a ramp or a chute.	A) Children have some understanding of machines. They show knowledge of the importance of machines in their daily lives. Children have some understanding of the importance of wheels. B) Teacher evaluation based on interest and participation within the group.
A) Question and Answer Book of Space, Sonneborn First Book of Space Travel Rockets to the Moon, Bergaust You Will Go to the Noon, Greeman B) Filmstrips: Rocket Power for Space Travel Bob's Rocket C) The Cincinnati Science Center	A) Children show that they have some idea of a rocket, how it works and its various uses in our world. B) Teacher evaluation through oral questions.

Concepts

Question: What makes a rocket move?
1. When hot gases move out one end of the rocket, the rocket moves in the opposite direction.
2. Most rockets carry both fuel and oxygen.

Question: How does a rocket work?
1. Several rockets or rocket stages are often put together. When a stage has used its fuel, it drops off to make the rest of the rocket lighter.
2. A rocket carries both its fuel and its oxygen.
3. Small rockets can be used to turn a rocket in space.

A) Teaching Methods
B) Learning Activities

Bring a model of a rocket so the children can see the three stages.
The children can draw the rocket either in flight or ready to take off.

Second Year Science

The Moon

Question: How does the moon look to you?
1. The moon seems small because it is so far away.
2. The moon shines by the reflected light of the sun.
3. The only part of the moon you can see is the part that is in sunlight.

Question: How does the moon seem to change its shape?
1. The sun is always shining on one half of the moon.
2. The side of the moon that has the sun shining on it is not always the side turned toward the earth.
3. The shape of the moon does not change. You see different amounts of its lighted surface as it revolves about the earth.

A) Reading and discussion.
Questions from the teacher.
Questions from the students.
Looking through magnifying glass and binoculars.
Discussion of pictures collected by teacher.

B) Demonstrations:
1. Use a ping-pong ball and a softball. Look at them close and at a distance. Also use a quarter and a dime in the same way.
2. Use a light bulb and a piece of aluminum foil to explain reflected light.
3. Make the moon's surface using sand or flour to show the trouble in landing on the moon.

Resources
A) Printed
B) Audio Visual
C) People
D) Places

A) Text: Learning in Science
Jacobsen, et. al.
American Book Company
Moon: Earth's Natural Satellite, Branley
Moon Seems to Change, Branley
True Book of Moon, Sun and Stars, Lewellen
You Will Go to the Moon, Greeman
The Moon, Brenna
B) Overhead Transparencies:
"Earth Science"
Filmstrips:
Night and Day
What Do We See in the Sky
Our Sky, Our Moon
The Earth in Motion
Flannel board - Ideal Company
Pictures collected by teacher
Chart on how the moon looks during a month
Films:
The Moon and How It Affects Us, Coronet
A Trip to the Moon
D) Trip to the Museum of Natural History by the parents.

Evaluation
A) Expected Outcome
B) Testing Program

A) Be able to draw how the moon looks at different times.
Be able to demonstrate and tell about reflected light.
To show an interest in the sky at night.
B) Evaluation should come from teacher through oral questions, signs of interest, participation in class discussion, demonstrations, etc.

Concepts	A) Teaching Methods B) Learning Activities
Question: What does the moon look like? 1. The telescope is a device which makes things far away appear closer. 2. The craters of the moon may have been formed when large rocks hit the surface of the moon. 3. You could not live on the moon because there is no air and water and because the temperatures are too extreme.	
Plants Question: In what ways do plants differ? 1. Green plants make their own food but many other types do not. 2. Some plants have roots, stems, and leaves. Some also have flowers and fruit. 3. Different plants grow by different means. 4. Plants differ greatly in size and shape. Question: What do plants need to live and grow? 1. Most plants need soil, water, air and light in order to grow. 2. Different plants need different amounts of soil, water, air and light in order to grow. 3. The structure of plants is related to where they grow. Question: How are plants used? 1. Plants are an important source of food. 2. Different parts of certain plants are used as food. 3. From trees we get paper and wood. 4. Parts of other plants are used to make clothes. 5. From molds, drugs are obtained which destroy germs.	A) Exhibition of plants to discuss, examine and observe. Reading and discussion. Questions by teacher. Nature walk to observe. B) Collection of leaves. Planting of seeds: give some water, some not. Do the same with light to prove the need for water and light. Start some plants from cuttings of other plants to show all plants do not come from seeds. Let bread mold - view it under a magnifying glass. Make a terrarium. Plant bulbs outdoors, also indoors. When finished blooming be sure to examine the bulb and root system. Chart on the uses of trees. Example: the different kinds of trees and what they give us.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
A) *Seeing New Things*, Frasier *Science Around You*, Craig B) Overhead transparencies: "Seasons and Living Things" Filmstrips: What Makes Seeds Sprout How Do Plants Get Where They Grow What Makes A Plant Grow How Do Plants Help Us Plants Trees Seeds and Seed Travelers How Apples Grow Finding Out How Plants Grow Pictures: a good source is seed catalogs. C) Mr. Wells, Hamilton County Park Board. D) Field trips: Krohn Conservatory Sharon Woods	A) To show an interest in living plants and trees. To be able to collect and identify leaves. To be able to identify a few of the more common trees. To be able to discuss how plants are used. B) To be able to answer questions about plants and to take part in the discussion about them.

Concepts

Soil

Question: What is soil?

1. The earth is covered with different layers of soil.
2. Soil is made of pieces of broken rock, dead plants, and dead animals.
3. Soil also contains air, water, and bacteria.
4. There are different kinds of soils. They may vary in color and composition.

Question: How is soil made?

1. Soil is made from plants, animals, and rock fragments.
2. Plants and animals are changed to soil after they decay.
3. Rocks are changed to soil by the action of plant roots and stems and plant acids.
4. Rocks are changed to soil by the action of wind, water, and extremes in temperature.

Question: How cnn soil be kept useful:

1. People take care of the soil by fertilizing, cultivating, irrigating, and properly planting in it.
2. Plants hold the soil in place so that water and wind will not carry it away.
3. Many little animals who live in the soil help make it more useful.
4. Farmers have many different ways in which to hold soil in place.

A) Teaching Methods
B) Learning Activities

A) Reading and discussion.
Experimenting and observing.

B) Observe an ant farm.
Field trip to a building excavation.
Collection of soil samples.
Use magnifying glass to examine the soil. List all that is found.
Crush up a rock to make soil.
Add water to dry soil and watch for air bubbles.
Rub a rock with sandpaper to show the wearing away of rocks by water or wind.
Freeze water in a jar so it breaks the jar to prove that ice expands and breaks rocks.
Plant beans in good soil and some in bad soil - note the difference.
Put earthworms in a gallon jar with dirt in it and observe their working, Note their value.
Make items out of clay and have the art department "fire" them.

Resources
- A) Printed
- B) Audio Visual
- C) People
- D) Places

B) Filmstrips:
- The Earth's Surface
- Our Friend the Earthworm

Overhead transparencies:
- Development of Soil

Pictures collected by teacher from magazines.

D) A trip to a stone quarry.

Evaluation
- A) Expected Outcome
- B) Testing Program

A) Children should show an interest in soil and its effect on us. They should be able to discuss the effects of soil on our lives.

B) Teacher evaluation through oral questions and discussion.

Concepts

Forces and Magnets

1. Inertia keeps things that are at rest where they are.
2. Inertia keeps moving things going.
3. Force is needed to make something move and to make a moving object stop moving.
4. Forces are pushes and pulls.

Question: What are some kinds of forces?

1. Gravity and friction are forces.
2. Gravity pulls everything toward the center of the earth.
3. The direction down is always toward the center of the earth.
4. Friction helps make things stop moving.
5. Friction may be helpful at times and of no help at other times.
6. There are ways in which the forces of friction can be changed.
7. The force of friction produces heat.

Question: What is magnetism?

1. Magnetism is a force.
2. Iron and steel things are attracted to a magnet.
3. Magnets will attract through things that are nonmagnetic.
4. The two poles of the magnet have the strongest force.
5. Opposite poles attract. Like poles repel.
6. The needle is a magnet, which is a compass, points to the magnetic poles of the earth.

A) Teaching Methods
B) Learning Activities

A) Reading and discussing.
Experimenting and demonstrating.
Questions and answers.
Observing and investigating.

B) Experiment to find out what the terms force and motion mean.
Experiment with toy cars to show that they keep going when pushed until something stops them.
Put something in the cars. Are they harder or easier to move?
A tug-of-war game will show the force of pull.
Demonstrate gravity with a ball, boy's cap, anything else that is dropped.
Rub hands together to show friction.
Have a box with books in it and try to push it. What would happen if it had wheels?
Place a little oil on the hands. Do you have as much friction?
Use a magnet to find all the things that are magnetic in the room.
Learn how to use a compass and discuss how it works,
Game: Draw, color, cut out fish from paper. Fasten paper clip to each fish. Tie a magnet to the end of a piece of string and suspend from a ruler (fishing rod). Go fishing in a bowl. You can use science words on the fish.

Resources
- A) Printed
- B) Audio Visual
- C) People
- D) Places

B) Filmstrips:
- How Wheels Help Us
- Magnets
- Permanent Magnets

Overhead transparencies
- Magnetism

D) Field trip:
- See an electromagnet at work

Evaluation
- A) Expected Outcome
- B) Testing Program

A) The child should be able to demonstrate and explain how a magnet and a compass work.

B) Teacher evaluation through oral questions and discussion.

Concepts

Food

Question: What is food?

1. Food is essential to good health and growth.
2. Water, while not a food, is also necessary to health.
3. Food and water are necessary everyday to maintain good health.
4. A good breakfast helps you get ready for work and play after you have been asleep for a long time.

Question: Why do you need food?

1. Food provides energy for the body.
2. The foods that provide energy are called sugars, starches, and fats.
3. The body stores excess energy foods as fat.
4. The body cells need protein foods to multiply.

Question: How does your body use food?

1. The food you eat must be changed to liquid before the body can use it.
2. The body must have oxygen in order to use food.
3. The joining of the liquid food and oxygen in the body provide warmth and energy.

Question: What kinds of food should you eat?

1. Starches, sugars and fat are used by the body for energy.
2. Proteins are used by the body for growth.
3. Minerals are necessary for health.
4. Vitamins found in many foods, help keep us well.

A) Teaching Methods
B) Learning Activities

A) Reading and discussing.
B) Demonstrations:
   1. To prove there is water in food place a fresh slice of bread or a cut potato under a glass and place in sunlight. After a half hour place in a shady place. Water will form on the glass.
   2. Testing foods for starch: put a drop of iodine on bread or crackers. It will turn blue. Test non-starch food such as onion.

Charts:
  Foods Animals Eat
  Foods We Eat

Health booklet:
  A good breakfast
  A good lunch
  A good dinner
  A good snack after school or before bedtime
  Brush your teeth after eating

Take several children's temperature and record on board. Compare and learn to read them.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) *Our Food*
What is a Cow?
What is a Chicken?
True Book of Health
B) Filmstrips:
  - Health
  - Billy Meets Tommy Tooth
  - Winning First with Teeth
  - Finding Out How You Grow

Charts:
  - The four kinds of food needed each day.
  - A good dinner with energy foods and protein.

C) The school nurse
A dentist
The district dietician
D) Field trips:
  - The dairy
  - The bakery

A) Expected Outcome
Evaluation B) Testing Program

A) Children should be conscious of the health habits regarding food. Their behavior in the lunch room improves. They try to eat foods they have never eaten before.
B) An oral quiz on food values and sources.

Concepts	A) Teaching Methods B) Learning Activities
Exploring Space Question: What is space like? 1. Space is dark except for the moon, sun and stars. 2. There is no wind or air in space. 3. There are pieces of dust and small rocks in space. 4. There is radiation in space. Question: What would you need to live in space? 1. Conditions in space are not favorable for man to live unless he takes certain precautions. 2. Food and water must be carried in space for survival. 3. Oxygen is necessary for the release of the energy in food. 4. A space suit and spaceship are needed to protect man in space from lack of air pressure, extremes in temperature, radiation, and meteors. Question: What happens on a journey into space? 1. A rocket can carry a man in a spaceship into space. 2. From space you can see the different parts of the earth. 3. In space the earth appears round. 4. To come back to earth, the spaceship must slow down and turn around; it may do so with the help of small rockets.	A) Reading and discussing. Experimenting and demonstrating. B) Show reflected light by using a mirror and a flashlight in a dark room. Remove mirror - the light is still present. But if you turn off the flashlight the light disappears even though the mirror is still in position. Sit in shade and sun - note difference in light and heat radiation. Make up menus for space flights. Demonstrate why the spaceship keeps moving after the rocket has stopped using a paper airplane.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Rockets to the Moon, Bergaust
Rockets, Missiles, and Space Travel, Ley
d) Pictures of rockets, spaceships, launching pads, etc. on bulletin boards. These can be found in magazines or from NASA.
A current bulletin board where children bring in pictures from newspapers and magazines.
Models
Filmstrips:
First Adventure in Space
D) Field trips:
A trip to Dayton Air Force Museum.
Natural History Museum (to view meteorites).

A) Expected Outcome
Evaluation B) Testing Program

A) To show an interest in today's space program.
To be able to talk about space travel with understanding.
To be able to draw a rocket ship.
B) Oral questions by the teacher.

Concepts	A) Teaching Methods B) Learning Activities
Science-Third Year	
The Air Around You Question: What is air? 1. Although we cannot see it, there is air all around us. 2. Air is made up of different gases such as oxygen, nitrogen, and carbon dioxide. 3. Air takes up space and can be weighed. 4. Air presses in all directions. Question: What is the atmosphere? 1. The earth is surrounded by an ocean of air called the atmosphere. 2. The atmosphere traps energy from the sun and protects us from harmful radiation. 3. Because of the weight of the atmosphere there is air pressure. 4. The air pressure becomes less as we go up in the atmosphere. Question: What happens when air is heated or cooled? 1. When air is heated, it expands. When it is cooled, it contracts. 2. Air that is heated tends to rise. Air that is cooled tends to sink. 3. Water enters warm air faster than cold air. 4. Water may leave the air when it is cooled.	A) Reading, discussing, Investigating, experimenting B) Demonstrations: Use a transparent bag- Pull through the air and close. Discuss what is inside. Use a balloon and blow it up. Put hand over it as you let air out. Questions-Do you feel anything? What do you feel? What is it? Where did it some from? How did it get in the balloon? Did you see it? Place a large glass jar over a burning candle. Why does the flame go out? Blow up a balloon-air Weigh a ball-let the air out and weigh it again. (Children's first experience with scales) Have 2 pans same amount of water in each. Which evaporates first-cool place-warm place? Find out how the temperature varies in a room. Chart- Record of air pressure for a week.
Weather Question: What is weather? 1. Changes in the air around us are weather. 2. The sun helps make changes in the air. 3. Some materials are heated faster than others.	A) Reading, discussion Investigation, experimenting

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Golden Encyclopedia
World Book Encyclopedia
Text: Learning in Science
Jacobsen et.al.
My WeeKly Reader
News Trails- Scholastic Weekly

B) Filmstrips
- Air Around Us
- What Makes the Wind
- Our Ocean of Air

C) A person from the Weather Bureau

D) Field Trips
Greater Cincinnati Airport's Weather Station
Weather Bureau of one of the TV Stations

A) Expected Outcome
Evaluation B) Testing Program

A) Children show that they are aware of the air around them, the how and why of air pressure.

B) Teacher evaluation through oral questions and discussion.

Concepts

Question: How does the moving of air affect the weather?

1. An air mass is a body of air that has certain characteristics.
2. The kind of weather we have depends on the kind of air mass over our area.
3. Air masses tend to move from west to east.
4. Whan two different air masses meet, we usually have bad weather.
5. Winds blow from places of high pressure to places of low pressure.

Question: How does water affect the weather?

1. Water that evaporates from lakes and oceans enters the atmosphere as water vapor.
2. When water vapor is cooled to a certain point, it condenses to liquid water and may take one of many forms (clouds, rain, dew, frost, etc.) in the atmosphere or on earth.
3. Water in its vapor form cannot be seen.

The Sun, Seasons, and Climate

Question: What is the sun?

1. The sun is a star. It is much larger than the earth.
2. The sun is one of a hundred billion or more stars in the Milky Way. It is much nearer to us than any other star.
3. The earth is one of nine planets in our solar system.
4. The sun is the source of most of our energy.

A) Teaching Methods
B) Learning Activities

A) Reading, discussion, Investigation, experimenting

B) Keep a weather chart.
Keep a chart of all the science words used in this unit.
Look at dew or frost through a magnifying glass.
Make frost by using one part salt to three parts ice in a tin pan. Let stand and frost will form on the outside.
Make a chart of the different cloud forms.
Make weather forecasts by looking at the clouds and reading a barometer.
Note weather maps on TV and report on them.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
A) How and Why Wonder Book of Weather The Lightning Bendick Wonders of the Atmosphere Weather Rain and Hail Storms Exploring the Weather Gallant All About Weather Tannehill Hurricane, Tornadoes, Blizzards Hitte	A) Children show understanding of weather and how it affects us. They actually adjust their amount of clothing to suit the weather B) Teacher evaluation through oral questions and discussion.
B) Filmstrips: Why Does it Rain Why Do We Have Warm and Cold Days Why Do We Have Wind Lightning and Thunder Weather Experiments Finding Out About Weather Overhead Transparencies: Weather Science	A) Children show through verbalization that they understand the nature of water vapor.
C) A person from the U.S. Weather Bureau or fromcne of the TV Stations	
D) Field Trip Greater Cincinnati Airport's Weather Station Weather Bureau of one of the TV Stations	

Concepts

Question: What are the seasons on the Earth?

1. Many parts of the earth have four seasons.
2. The amount of energy received by a section of the earth depends upon the angle at which the sun's rays strike the ground.
3. It takes the earth a year to revolve around the sun.
4. The axis of the earth is always pointed in the same direction.
5. When the northern half of the earth is tilted toward the sun there is summer in the north and winter in the south. When the southern half of the earth is tilted toward the sun, there is summer in the south and winter in the north.

Question: What is climate?

1. Climate is all the weather a place has.
2. The climate depends on how much energy a place gets from the sun.
3. The climate is affected by the height, nearness to water, and the kinds of winds that blow.

Satellites

Question: What are satellites?

1. Satellites travel around larger objects in oval (elliptical) paths.
2. Satellites are held in orbits by the force of gravitation.
3. Satellites move faster when they are near the larger object than when they are farther away.
4. We can see earth satellites as they reflect sunlight to us. They seem to move across the sky.

Question: How are Earth satellites put into orbit?

1. Earth satellites are given a push sideways so that they fall around the earth.
2. Earth satellites are sometimes put in orbit with three-stage rockets.

A) Teaching Methods
B) Learning Activities

A) Reading, discussing, investigating, experimenting

B) Make a chart- what we know about the sun on one side, and what we want to learn about the sun on the other

Write a story- the sun takes a vacation

Make a chart of the science words used in this unit. By going over them every day for review they become a part of the child's vocabulary.

Make pictures depicting the four seasons.

Make a chart of the four seasons listing all the concepts learned in this unit.

Compare our climate with another area such as a country that is being studied in Social Studies. Bring out how the climate affects as to how we live.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Solar Energy
Sun: Star Number One
The Sun
Branky
Worlds in theSky
Fenton
Exploring the Sky
Gallant
Fun with Astronomy
Seasons

B) Filmstrips:
Moon, Sun and Stars
To Everything a Season
The Seasons

C) U.S. Weather Bureau
Hamilton County Weather Bureau
U.S. Department of Agriculture

D) Visit a Planetarium
Visit an observatory and look through a telescope.

A) Expected Outcome
Evaluation B) Testing Program

A) Children ask questions about the sun; they tell what they have observed about it.

B) Oral questions and discussion
A quiz-written- fill in blanks

Concepts	A) Teaching Methods B) Learning Activities
Question: How do satellites stay in their orbit? 1. The force of gravitation plus the sideways motion imparted to the satellite by a rocket makes a satellite fall in an oval-shaped orbit. 2. A scale on which an object is weighed in a satellite will show no weight because the scale is falling as fast as the object. 3. A satellite keeps falling around the earth because there is very little friction in space to stop it.	A) Reading, discussing, investigating, experimenting B) Make a chart of the science words used in this unit. Be sure the children know them and their meanings Draw a picture of the sun and its satellites Drop a felt piece of paper and a crumpled piece of paper at the same time from the same height Compare the paths and the rates of fall to review the basic concept of friction Another friction experiment would be:children coast on roller skates. When do they go the fastest? Do the skates get hot? Why? Make a chart of what scientists would like to learn from satellites and what they have already learned from them. Have the children make a bulletin board of the different types of satellites.
Question: How are earth satellites used? 1. Satellites can be used to photograph clouds, send radio and television signals, and study objects in space. 2. Radio and television signals travel in a straight line. 3. Stars and planets can be viewed better from above the atmosphere.	
Living Things On the Earth	
Question: What are living and nonliving things? 1. Living things move by themselves, grow and produce other things like themselves. 2. Plants and animals are living things. 3. Living things need food and water and oxygen from the air to stay alive. 4. Living things have adaptations that help them to get the things they need.	

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) S is for Space
Bradbury
First Book of Space Science
First Men inSpace
Rockets, Missles and Moons
Rockets, Missiles and Space Travel
Rockets to the Moon
Polaris
Baar
R is for Rocket
Bradbury
Space Ships and Space Travel
Ross
A Book of Satellites
Crowell

B) Filmstrips:
The Thor Missle Story
Transparencies:
Reflection of Light

D) Cincinnati Science Center
Union Terminal

A) Expected Outcome
Evaluation B) Testing Program

A) The child speaks positively about news reports of satellites, etc.

B) Written test of a very simple type, such as true and false or or fill-in-the-blanks

A) Children show that they comprehend the notion of friction

Concepts

Question: How do living things grow?

1. All living things grow. They grow from the inside.
2. Living things grow as cells grow and divide.
3. Most cells in living things are periodically replaced by new cells.
4. Living things produce new living things like themselves.

A) Teaching Methods
B) Learning Activities

A) Reading, discussion, investigating, experimenting, research

B) Divide the things in the room into living and nonliving groups Discuss why you put them where you do. Where do you go?

- -Introduce words such as graze browse, and gnaw.
- -Grow some green plants-beans are easy to grow. Place one in a dark place for a few days. What happens to the plant? Put it back in the sun. Watch to see what happens.
- -Discuss photosynthesis and what it means.
- -Put celery in a glass of colored water to show how plants get water and food from soil
- -Draw a picture showing how energy comes from the sun.

- -Trace some food you eat back to the sun
- -Note the difference between getting bigger and growing
- -Start some plants such as coleus or philodendron in water. Watch root system.
- -Let bread mold in a plastic bag-Look at it through a magnifying glass.

Resources
A) Printed
B) Audio Visual
C) People
D) Places

A) Questions and Answers
Book of Nature
Grow it Book
Baker
Living Things
Useful Plants and Animals
How the Sun Helps Us
Blough

B) Filmstrips:
What Makes a Seed Sprout
What Makes a Plant Grow
Where Animals Come From
Seeds and Seed Travelers
The Caterpillar's Journey
How You Grow
Living Things
Birds that Live Near Us
Transparencies:
Seasons and Living Things

C) Mr. Wells, Hamilton Park Board

D) Field Trips
Sharon Woods
Krohn Conservatory of Flowers
Natural History Museum

Evaluation
A) Expected Outcome
B) Testing Program

A) The child expresses pleasure in the world around him
He can tell about some of the needs of all living things, including the needs of the human body

B) Oral questions and discussion
Tests, such as drawing pictures of living things and nonliving things

Concepts

The Sounds You Hear

Question: What are Sounds?

1. There are many different kinds of sounds.
2. Sounds are made by vibrations.
3. Frequency is the number of times a second that something vibrates.
4. The kind of sound we get depends on how fast something vibrates.
5. The kind of sound we get depends on how tightly something is stretched.

Question: How do sounds travel?

1. A material substance is needed for sounds to travel.
2. Sounds travel as waves.
3. Sound waves can be directed and reflected.
4. Sound waves do not travel as fast as light.

Question: How do you hear sounds?

1. Sound waves are received by the ear.
2. In the ear, sound waves set up messages that travel to the brain.
3. It is important that our ears be given proper care.

A) Teaching Methods
B) Learning Activities

A) Reading, discussing, investigating experimenting, researching

B) Give the children a piece of paper and a rubber band and give them a few minutes to see how many different sounds they can make.
Make some musical instruments.
Place some fine paper on the outer side of a comb and blow through the teeth. This is a good way to illustrate vibration.
Fill drinking glasses with different levels of water. Experiment with the different sounds by hitting the glass with different things.
How can people on the moon communicate?
Experiment with sounds through solids, water and other things Also, with echoes and how they help us, and ways to stop sounds.
Draw a diagram of the ear
Why do some animals hear things we cannot hear?

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) All About the Human Body
Glennser
Your Ears
Sounds We Hear
Grosset and Dunlap

B) Transparencies
The Human Body(section on the ear)

C) Have someone from the music department bring in different instruments and illustrate the sounds
The school nurse
A doctor

A) Expected Outcome
Evaluation B) Testing Program

A) Children talk intelligently about the sounds around them. They understand the ear and how they should take care of their ears.

B) Oral testing by the teacher. Let the children make up the questions.

Concepts

A) Teaching Methods
B) Learning Activities

Fourth Year Science

The Earth and Its History
Question: How was the earth formed?
1. Hypotheses are scientific suggestions based on facts and used to find new facts.
2. Several hypotheses have been made to explain how the earth was formed.
3. Scientists believe that the earth was very hot when it was formed and it changed as it cooled.
4. The earth is somewhat like a sphere but flattened at the poles.
5. The earth is made up of crust, mantle and core.
6. Age of the earth is estimated by the layers of rocks.
7. The history of the earth has been divided according to certain characteristics and events into eras.
8. Volcanoes, earthquakes, and glaciers caused great changes on the surface of the earth.

Question: What kinds of rocks are found on the earth?
1. Rocks are grouped according to how they were formed; the three groups are igneous, sedimentary, and metamorphic rocks.
2. Igneous rocks are formed from hot liquid magma which seeps from cracks within the earth.
3. Sedimentary rocks are formed from the eroded rock materials which are carried to bodies of water and settle to the bottom in layers.
4. Metamorphic rocks are of igneous and sedimentary origin, having been changed by heat and pressure.

A) Reading, discussing, investigating, observing, questioning and testing.

B) Make a chart of all the Key Science Words.

Take a walk around the block to look for evidence of weathering and erosion.

Have some pupils report on how deep the deepest coal mines, diamond mines, and gold mines are. What is their temperature? What would happen to the drill head if it were used to drill very deep into the earth?

Display a picture of the Grand Canyon. Have a pupil report on the layers of rock.

Perhaps a Geiger counter could be borrowed from the high school science department.

Dinosaurs lived during the Mesozoic era. The class will enjoy studying them. Pictures and models of them can be displayed. Reports and stories may be read.

Make a diorama or a large picture illustrating the various eras.

Make a model of a volcano out of clay, plaster of Paris or papier-mache.

Have a pupil report on Paricutin. Also on Kilauea Iki.

Have a rock collection. Scrape off particles from shale - look at them under a magnifying glass. Compare with particles from sandstone.

Display a piece of coal and report on its origin, uses, etc.

Resources
A) Printed
B) Audio Visual
C) People
D) Places

A) All About Volcanoes and Earthquakes, Pough
The True Book of Rocks and Minerals, Podendorf
What's Inside the Earth, Zim
True Book of Conservation
All About the Planet Earth
Rocks and Minerals
World Book Encyclopedia
Compton's Pictured Encyclopedia
Text: Probing Into Science
Jacobsen, et. al.
American Book Company
B) Filmstrips:
Rocks and Minerals
The Earth's Surface
Up Through the Coal Age
Hunting Fossils
Stories That Fossils Tell
How Rocks Are Formed
Overhead transparencies:
Earth Science
Rock Cycle
Rock and mineral kit
D) Field trips:
Natural History Museum
Cincinnati Science Center - Union Terminal

Evaluation
A) Expected Outcome
B) Testing Program

A) Children show an interest in how our earth was formed.
The children collect rocks and want to know more about them.
The children show an understanding of the natural, physical world.
B) Teacher evaluation through oral discussion and questioning.
Teacher made test on the unit - testing the points brought out in class.
Do the test on page 47.
A) Children talk about interesting natural rock formations which they have visited with their families.

Concepts

Prehistoric Plants and Animals

Question: What is known about prehistoric times?

1. One of the ways scientists learn about prehistoric life is by studying fossils.
2. Minerals in water helped make petrified fossils.
3. Volcanic ashed helped make mummified fossils.
4. Fossil skeletons have been found in amber and in tar and asphalt pits.
5. Scientists devised time charts to organize knowledge of prehistoric times.
6. Early forms of life slowly changed from one-celled to many-celled living things.
7. Simple algae and protozoa lived during the Precambrian era.

Question: What kinds of life were in the Paleozoic Era?

1. The first plants to live both on land and in water developed during the Paleozoic Era.
2. Land plants that died in swamp slowly changed to coal.
3. Animals more complex than protozoa developed during the Paleozoic Era.
4. Fishes were the first vertebrates.
5. Amphibians were the first land vertebrates.
6. Insects and reptiles appeared during the late Paleozoic Era.

Question: What kinds of life were in the Mesozoic Era?

1. Seed plants developed and spread during the Mesozoic Era.
2. The first trees were ancestors of the conifers.
3. Many kinds of reptiles developed during the Mesozoic Era.
4. Dinosaurs developed and became extinct during the Mesozoic Era.
5. The first birds developed in the Mesozoic Era.

A) Teaching Methods
B) Learning Activities

A) Reading, discussing, researching, chart-making, demonstrating.

Make a chart of the science key words - go over them every day.

B) Show how a fossil is made using clay and a leaf.

Have a student report on Mt. Vesuvius and how Pompeii was covered..

Have a piece of petrified wood and find out more how it was formed.

Place a piece of green algae under a microscope - note the cells. Also examine some drops of pond water.

Demonstrate how sediments settle in water to form layers.

Maybe the children can bring in models of dinosaurs.

Bring out the differences between modern birds and flying reptiles of the Mesozoic Era. Also compare reptiles of today with those of the Mesozoic Era.

Do a series of experiments to prove the strength of seeds, such as freezing some and others in a very warm place. Plant them and see if they will grow under the same conditions.

Point out how animals adapt to their environment.

Draw pictures of the various plants and animals that inhabited the earth in the four eras.

Find out why the dinosaurs became extinct.

Grow some live specimens of simple one-celled animals such as paramecium and ameba.

On a map of the United States color in where coal has been found.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) The Grand Canyon Hike
All About Dinosaurs, Andrews
All About the Strange Beast of the Past, Andrews
: Dinosaurs, Zim
Prehistoric America, White
B) Filmstrips:
    Up Through the Coal Age
    When Reptiles Ruled the Earth
  Overhead transparencies:
    Earth Science
D) Field trips:
    Fossil hunting trip
    Natural History Museum

A) Expected Outcome
Evaluation B) Testing Program

A) Children show an interest in the beginning of our world.
They talk about prehistoric times and collect fossils and dinosaur models.
The children listen with interest to others in the class and respect their viewpoint.
B) Book test page 95.
Teacher made test using multiple choice, essay, and recall.

Concepts

A) Teaching Methods
B) Learning Activities

Question: What kinds of life were in the Cenozoic Era?

1. The Cenozoic Era started 65 million years ago.
2. Hardwood trees and grasses developed during the Cenozoic Era
3. The first mammals, which are warm-blooded animals, first appeared about 70 million years ago.
4. The types of mammals that are found today developed during the Cenozoic Era.
5. Man probably appeared on the earth more than one million years ago.
6. Scientific knowledge of early man comes from the study of fossils, skeletons, bones, tools, and such evidence that has been found.
7. Man has many advantages, such as a highly developed brain, that other forms of life do not have.

Make a list of the animals that are in danger of becoming extinct now and why they are.
Research on animals such as snails, sponges, coral, etc. as to how they eat, move, and function.
Make a collection of insects. Why were there so many insects in the Paleozoic Era?
Make a collection of cones of the evergreen trees.

Materials of the Earth
Question: What is matter?

1. Matter is anything that has weight and takes up space.
2. The three states of matter are solid, liquid, and gas.
3. All matter is made up of atoms of which there are more than 100 different kinds.
4. Atoms can join together to form molecules, which are the smallest particles of a substance having all the properties of that substance.
5. The freedom with which the molecules of a substance can move determines its state.

A) Reading, discussing, experimenting, observing.
B) Demonstrate that air is matter by placing a crumpled piece of dry paper in a glass - so it will not fall out. Plunge the inverted glass into a pail of water. Does the paper get wet? Do it again- this time tilt the glass so air bubbles can escape.
Be sure the pupils can describe a liquid correctly. Experiment with water in a variety of containers.

Resources
A) Printed
B) Audio Visual
C) People
D) Places

A) Greg's Microscope
New Worlds Through the Microscope
Experiments in Science
Fire in Your Life, Adler
Picture Book of Salt
The ABC's of Chemistry
B) Filmstrips:
Fire
Wonders of Chemistry
D) Visit an industrial laboratory.
Watch a chemist at work.
Notice the tools he uses.

Evaluation
A) Expected Outcome
B) Testing Program

A) The children show awareness of the physical and chemical changes that they come in contact with every day.
B) Teacher evaluation through oral questions, pupil interest, questions and insight.

Concepts

Question: What are physical changes?

1. A physical change involves only the shape or state of a substance; the molecules are not altered.
2. Matter may be changed from one state to another by raising or lowering its temperature.
3. When a substance is dissolved in a liquid, it takes another form but its molecules remain the same.

Question: What are chemical changes?

1. A chemical change is one in which the composition or structure of molecules in a substance is changed.
2. Burning is a chemical change in which a fuel combines with oxygen to form carbon dioxide.
3. A fuel, oxygen, and enough heat are needed for burning to occur.
4. Oxidation, the chemical union of oxygen and other suvstances, may be rapid or slow.
5. Elements are substances made of atoms which are all alike; elements cannot be broken down into simpler substances.
6. Compounds are substances made when the atoms of two or more elements join together; all the molecules of a compound are alike.
7. Mixtures are materials composed of two or more substances which keep their own characteristics; the molecules of a mixture are of two or more different kinds.

A) Teaching Methods
B) Learning Activities

B) To illustrate property of gases- spill some perfume on a sheet of paper. You can smell it because it changed from a liquid to a gas. Are the molecules of the gas close together or far apart? (far apart) What is the container for the gas? (the room)

Put water in two containers - one with a large opening - one with a small opening. Put the same amount of water in each. Let stand in sun for several days. Which container lost more water? Why?

Dissolve several things in water; such as sugar, salt, flour, sand. Which can you see? Which can you not see? Let it stand for a few days - what can you see then?

An iron nail placed in a glass of water for a couple of days will show slow oxidation. A candle burning will show fast oxidation.

Report on the discovery of plastic. What was so good about it?

Make a chart of the physical and chemical characteristics of several common substances.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

Concepts

Energy to Do Work

Question: What are work and energy?

1. Work is done only when something is moved through a distance.
2. The amount of work done depends on how far something is moved and the push or pull needed to move it.
3. A force is a push or pull; while the force itself is invisible, its results can often be seen and measured.
4. Energy is the ability to do work.
5. The energy of moving objects is called kinetic energy; stored up energy is called potential energy.

Question: What are some forms of energy?

1. Some forms of energy are mechanical, light, sound, heat, electrical, and nuclear.
2. Chemical energy can be released slowly or rapidly.
3. Sound energy is due to a vibrating object producing sound waves in the air.
4. At high temperatures molecules move very rapidly.
5. Many forms of energy can be changed into electrical energy.
6. A great deal more energy can be obtained from nuclear energy than from chemical energy.

Question: How is energy changed?

1. Potential energy can be changed into kinetic energy and back to potential energy again.
2. One universal law is that energy can be changed from one form to another, but the total amount of energy always remains the same.
3. Under certain conditions matter can be changed into energy and back again. This is the Law of Conservation of Matter-Energy.

A) Teaching Methods
B) Learning Activities

A) Reading, discussing, observing, experimenting, researching.

B) Experiment: Have each child hold a book in one hand and a ruler in the other. Have them lift the book as high as the ruler. Did all children do the same work? Discuss the amount of work done by the individual pupils.

Experiment by making scales and balances or using simple ones that were bought.

Have the children write a short paragraph on "What Goes Up Must Come Down".

Have a tug of war on the playground to experiment with the concept of pull.

Look up some facts about weight - lifting. Discuss the danger of trying to lift too heavy objects.

List on a chart or the chalk board many kinds of kinetic energy, potential energy, chemical energy.

Report may be be made on how running water can produce electricity. List the many places this is done.

Report on how we get electricity for our classroom. What kind of energy is used?

Bulletin board - Show the sun and the many ways we can trace energy from it.

Have an exhibit of different forms of energy - children's toys are often run by battery. Some by wind, water, push, etc.

Make sure the children know and understand the meaning of the words conservation and law.

A chart can be made of the Uses of Fire.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Machines at Work, House
All About Electricity, Freeman
Electricity in Your Life
Machines
Sounds We Hear
Biography for an Atom, Branowski
World Book Encyclopedia
Compton's Pictured Encyclopedia
Britannica Junior Encyclopedia
B) Filmstrips:
Electricity
The Sounds We Hear
Power
C) The high school science teacher might bring some lab equipment and do some of the suggested experiments.
D) Field trips:
Visit an electric generating plant.
Visit a construction sight to view different forms of energy.
Visit a house that is being built, before the walls are up, where the electrical wiring can be seen.

A) Expected Outcome
Evaluation B) Testing Program

A) Children should demonstrate an understanding of the different forms of energy, and how they are used every day by themselves and their parents.
Children should have a better understanding of how different forms of energy are related to one another.
B) The children should be able to complete the exercise on page 191 in text.
Teacher made test over the unit.
Teacher evaluation through oral questions and discussions.

Concepts

Exploring the Solar System

Question: What is the solar system?

1. The solar system system is made up of the sun and all the objects that move around the sun.
2. Some of the objects in our solar system are: the planets and their moons, the asteroids, comets and meteors.
3. Planets can be distinguished from stars by the light each gives off and by the fact that that the planets seem to move among the stars, while the position of the stars remains fixed in relation to one another.
4. The planets seem to move across the sky because both they and the earth are revolving around the sun.

Question: What are the planets like?

1. Nine planets revolve about the sun.
2. The planets differ in size, distance from the sun, and surface conditions.
3. Many of the planets have moons revolving around them.
4. Between Mars and Jupiter lies a belt of asteroids which are small bodies that revolve around the sun.

Question: How are telescopes used?

1. Telescopes are instruments for observing the heavens. They may be reflectors or refractors.
2. Balloon telescopes make for clearer observing since they bypass the earth's atmosphere.
3. By applying the law of gravitation, astronomers have been able to discover some heavenly bodies which were not previously known.

A) Teaching Methods
B) Learning Activities

A) Reading, discussing, observing, experimenting, questioning, and testing.

B) The children make a notebook of pictures, charts, reports and stories.

More able children report on the lives of Copernicus, Galileo and Newton. Also more about Brahe and Kepler.

Reinforce the terms revolve, revolution and reflection.

Have a pupil report to class about any meteorites that have fallen to the earth.

Make a mobile using balloons covered with papier-mache. They can be painted and hung on a wire to represent the distance from the sun. Moons can be fancy topped pins.

Have a pupil give a report on Halley's Comet.

Contact Natural History Museum for information concerning time and place for planetry observations. Encourage the children to observe at night. If a telescope is available, set it up for an evening. Many children and parents would be interested.

Divide into eight groups and have each group choose a planet and write a story about the life on that planet.

Learn to use the word focus and experiment with a magnifying glass to understand the term.

Make a circle in the classroom 200 inches in diameter to show the size of the Hale telescope in California. Maybe all the children can stand in it. Imagine how much light a telescope like this can gather!

Resources
A) Printed
B) Audio Visual
C) People
D) Places

A) A Book of Satellites, Cromwell
Sun, Moon and Stars, Freeman
Question and Answer Book of Space, Sonneborn
The Earth Satellite, Lewellen
Stars in Our Heavens
S is for Space
A Book of the Milky Way Galaxy For You, Branley
Moon Seems to Change, Branley
Book of Astronauts for You, Crowell
First Book of Space Travel
Fun with Astronomy, Freeman

B) Overhead transparencies:
  Reflection of Light
Filmstrips:
  Basic Astronomy
  The Thor Missile Story
  How We Learn About the Sky
  Sun's Family
  The Stars
  Solar System
  Multitude of Suns
Bulletin Board:
  Pictures of solar system
  Pictures of rockets and space probes with receiving stations

D) Field trips:
  Natural History Museum
  Planetarium

Evaluation
A) Expected Outcome
B) Testing Program

A) The children should show an awareness of the solar system and the earth's place in it.
The children should show an interest in the space program of the United States.

B) Teacher evaluation through oral questions and discussion.
Test on page 239.
Teacher made test.

Concepts	A) Teaching Methods B) Learning Activities
Question: How are space probes used to explore the solar system? 1. Space probes are laboratories that are sent into space by rockets. 2. Space probes are carriers of instruments that measure many properties of space. 3. The instruments in the space probe get electricity from the sun by the use of solar cells. 4. Space probes send back the information they gather in coded radio signals. 5. A space probe has to be aimed ahead of a planet in order to reach it. 6. Much data about Venus has been gathered by the use of space probes.	B) What does decode mean? Make up a code that might be used in a space probe. Experiment with two pupils - one being a planet, the other being a space probe. Find out how the space probe could come near the planet.
Living in Space Question: What makes life possible on Earth? 1. Certain special conditions are needed for life. 2. Living things need food, water, oxygen, and the proper temperature range. 3. The atmosphere exerts a necessary pressure against the body. 4. The atmosphere protects man against radiation. 5. Gravity is much less out in space. Question: What affects life in space? 1. Outer space is a vacuum which cannot support life. 2. In space there are gases, meteorites, and almost all kinds of radiation. 3. Sound does not travel through a vacuum. 4. An object has weightlessness in space.	A) Reading, discussing, researching, questioning, and testing. B) Have the pupils plan a trip to the moon. Class committees can decide what they must take with them. Have an able pupil to find out how the temperature in a satellite is controlled. Have an able pupil find out the relationship between the tides and the moon. Report on the origin of meteors and why they burn up. Report on how the magnetosphere was discovered. Find out what you would weigh on the different planets. Have the children put on little skits to demonstrate how they move or eat in a weightless condition.

Resources
A) Printed
B) Audio Visual
C) People
D) Places

A) *The First Book of Space Travel*, Watts
A Book of Astronauts for You, Crowell
National Geographic
Other magazines that have pictures and articles on space living.
World Book Encyclopedia
Compton's Pictured Encyclopedia
Colliers Encyclopedia
Britannica Junior Encyclopedia
B) Filmstrips:
First Adventures in Space
Space and Space Travel
C) A skin diver could tell the children how they adjust to changes in pressure underwater.
D) Field trip:
Dayton Air Force Museum

Evaluation
A) Expected Outcome
B) Testing Program

A) The children show an interest in the space program.
The children read stories and books on space.
The children collect space pictures or models.
B) Teacher evaluation through oral questions and discussing and interest shown.
Test on page 287 in text.
Teacher made test.

Concepts	A) Teaching Methods B) Learning Activities
Question: How can man live in space? 1. In a spacecraft man has to have oxygen, food, water and the proper temperatures. 2. Air pressure must be provided in a spacecraft. 3. The spacecraft has to be protected from meteors. 4. Plants in a spacecraft can perform many useful functions. 5. A spinning space station could have an effect like that of gravity. 6. Astronauts can use small rockets to steer spacecraft in space and radios to communicate in space. 7. The shape of the spacecraft and a heat shield protect the astronaut during re-entry.	B) Bring out how far it is to the moon by saying it would take 500 years to walk to the moon, if it were possible- 50 thousand years to walk to Venus. Discuss why instruments are sent to the moon first. What will man have to take with him? Discuss the re-entry methods by which a spacecraft comes back to earth. Discuss how it would be on the moon.
Fifth Year Science The Earth and Its Changing Surface Question: How is the surface worn away? 1. Scientists learn about the earth's past by studying the changes that are occurring in the present. 2. The earth's surface is always changing; the changes usually take place over very long periods of time. 3. Some changes, such as those caused by heat and pressure within the earth, tend to build up the earth's surface. Other changes, such as those caused by the action of running water, wind and ice, tend to wear away the earth's surface.	A) Reading, inquiring, observing, questioning, doing. B) Try to find pictures of the Alaskan earthquake of 1964. Discuss them. Look up the work of a beaver as a preventer of erosion. Have pupils look up and report on such terms as: berm, scarp, foreshore, backshore, inshore, and headland. Discuss how we can help prevent erosion. Have a rock collection of granite, limestone, conglomerate, lava, etc. Assign the different volcanic eruptions to several children to report on. They may bring in pictures, too.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Text: Inquiring into Science
Jacobsen, et. al.
American Book Company
Young Citizen - Scholastic Classroom Weekly
Weekly Reader
Life Magazine
Science Year - World Book
Mountains on the Move - Coward
First Book of Volcanoes and Earthquakes, Watts
Deep in Caves and Caverns, Dodd
World Book Encyclopedia
Compton's Pictured Encyclopedia
Colliers Encyclopedia
All About Volcanoes and Earthquakes, Pough
Earth's Crust
Rocks and Their Stories, Fenton
Rocks, Rivers and the Changing Earth, Schneider
Story of Caves, Sterling

A) Expected Outcome
Evaluation B) Testing Program

A) The children have a better understanding of the environment in which they live.
B) Review unit using the section Remember.
Test on page 62.
Teacher made test using about four essay type questions.

Concepts

Question: How is the surface built up?

1. Forces are at work which biild up the surface of the earth.
2. Volcanic action builds up the surface of the earth by transporting materials from the interior to the surface.
3. Mountains are formed by the sideward pressure of rock layers.
4. Deposits of soil by rivers during flooding build up the surface of the earth; soil deposited at the mouths of rivers also builds up land.

Question: What is beneath the surface?

1. Most of what we know about the interior of the earth is a result of indirect evidence.
2. The earth is made up of three layers: the crust, mantle, and core.
3. Earthquakes are sudden slippings of rock along a fault; they are most frequently evidenced in certain areas called earthquake belts.

A) Teaching Methods
B) Learning Activities

B) Make a model of a volcano using papier-mache.

Report on the meaning of delta - bring out New Orleans is built on a delta.

Make a model of the earth using four colors of clay - then cut it in two.

Have the children read about tsunamis of the past and report on the Hawaiian warning system.

Bring out that whatever forces were acting in the past are acting in the present. Therefore scientists study the changes taking place today to learn about past changes.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

B) Pictures of caves, shores of the ocean, different rivers, wind erosion, glaciers, and sand dunes.
  Filmstrips:
    The Earth's Surface
    The Soil
    Violent Forces of Nature
    Our Earth is Changing
    Story of Rivers
    Our Ever Changing Earth
  Overhead transparenciss:
    Earth Sciences
    Structure of the Earth

C) Someone from the weather station to bring a seismograph and explain it.

D) Field trips:
    To the cave at the Natural History Museum or Ohio Caverns.
    Take a walk and note signs of erosion.
    Note the Ohio River and Mill Creek to answer the question:
      Is it an old or young river?
      Note deposits of sand and dirt.
      Note erosion along the banks.
      Dies it flood? Why?

Concepts

Changes in Matter

Question: What is chemistry?

1. Chemistry is the science that deals with matter and the changes in matter.
2. All matter is made of atoms, which may combine to form molecules.
3. There are three kinds of matter: elements, compounds, and mixtures.
4. An element is the simplest kind of matter. All atoms in an element are alike. Atoms of different elements differ.
5. A compound is a substance in which each molecule has two or more different atoms chemically combined.
6. A mixture is a substance in which different types of molecules are not chemically combined.
7. Symbolic expressions are used in chemistry. A single symbol represents an element; a combination of symbols, called a formula, represents a compound; a chemical equation uses symbols to express a chemical change.

Question: What are some important substances?

1. Oxygen is necessary for life.
2. Carbon dioxide is present in air, is necessary for photosynthesis and does not burn.
3. Hydrogen is the simplest of all elements.
4. Water exists as a solid, liquid, and gas.
5. The motion of molecules explains evaporation, while the attraction of water molecules explains condensation.
6. Pure water, obtained by distillation, filtration, aeration, or chlorination, is necessary for life.

A) Teaching Methods
B) Learning Activities

A) Reading, discussion, questions, demonstrations, experiments, observations.

B) Review - What is matter? What is an atom?

What is meant by synthetic materials? List some and discuss how they are used.

Bring out that a mixture can be put together in any proportions, while a compound combines only in one particular proportion. Also a mixture retains the properties of its individual ingredients, while a compound has completely different properties from those of the elements of which it is composed.

See if pupils can trace the cycle of oxygen from the air going through the body and eventually being converted back to pure oxygen in the air.

Have a pupil find out what inert gases are? Will oxygen combine with the inert gases?

Is there any water present on another planet? Why or why not?

What would happen to fish in boiled water that has been cooled?

What do they do to water in swimming pools to make it safe?

Have a pupil report on how crude oil oil is refined.

Make a coal flower by using salt, bluing and ammonia.

Have a pupil report on how plastic is made. List the uses of plastic. Classify them according to physical properties such as brittleness, melting point and so forth.

Resources
A) Printed
B) Audio Visual
C) People
D) Places

A) Many chemical companies will send free copies of charts of atoms.
The Story of Chemistry
The First Book of Water, Watts
Experiments for Young Scientists, Little
Molecules and Atoms
Fibers
Great Experimenters
Resources for Tomorrow, Beeler
Science Experiments with Water, Rosenfeld
The True Book of Rocks and Minerals, Podendorf
True Book of Chemistry
Encyclopedias

B) Filmstrips:
Science at Work
Atoms and Their Energy
Chemical Changes
Atoms and Molecules

C) Have a high school chemistry student bring materials and demonstrate some of the experiments suggested in this chapter.

D) Field trips:
Visit a water purification plant.
Visit a sewage disposal plant.

Evaluation
A) Expected Outcome
B) Testing Program

A) The children show an interest in chemistry.
They find chemistry pretty much like a mystery and work to solve the mystery.

B) Use page 110 as a review.
Do test on page 111.
Give each child a report to do on one aspect of chemistry.

Concepts	A) Teaching Methods B) Learning Activities
Question: What is the importance of carbon? 1. Organic chemistry deals with the chemistry of carbon compounds. 2. Charcoal, graphite, diamond, and coke are different forms of the element carbon. 3. There are many hydrocarbons because carbon has the property of covalent bonding. 4. Isomers are hydrocarbons that have the same number and kind of atoms but different structures. 5. In substitution products, elements are substituted for the hydrogen in hydrocarbons. 6. Many new hydrocarbons can be produced.	
Living Things in Their Environment Question: What are the characteristics of living things? 1. All living things are alike in certain ways: they can respond to stimuli, move, grow, get and use food, and reproduce. 2. All living things are made of one or more cells. 3. Protoplasm is the living material within each cell. 4. Each cell is surrounded by a cell membrane, and is made up of a nucleus and cytoplasm. Only plant cells have cell walls. 5. Cells which are grouped to perform certain functions form tissues. 6. Different kinds of tissues combine to form an organ. 7. Organs are organized into such systems as the skeletal system, digestive system, excretory system, respiratory system and nervous system.	A) Reading, observing, examining, experimenting. B) Have a pupil report on the history of microscopes. Chart: Plants and animals -- how they are alike. Look at scum from a pond under a microscope. Have the children keep a notebook on this unit. Have the pupils make a large diagram of the digestive system. Label each organ - describe its function. Draw the heart - what is its function? Look at a drop of blood under a microscope. Why are red corpuscles so important? Draw the lungs - what is their function? Draw the brain - what is its function? Examine some pork or beef brains.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Science in Your Own Back Yard
Grow It Book, Baker
Leaves
Useful Plants and Animals
First Book of Plants, Watts
Plants of Woodland and Wayside

B) Filmstrips:
- Finding Out How Plants Grow
- Up Through The Coal Age
- To Everything A Season
- Seeds and Seed Travelers
- Our Friend the Earthworm
- The Caterpillar's Journey
- How Apples Grow
- Plants
- Trees

C) Invite a local florist or gardener to talk about care of plants.

D) Field trips:
- Zoo
- Krohn Conservatory

A) Expected Outcome
Evaluation B) Testing Program

A) The children have an interest in the living things aobut them.
The children appreciate the beauty of living things.
The children learn to not destroy plants and animals.

B) Review with page 174.
Test on page 175.
Science exhibit with all the activities done in this unit. Invite other classes to look at it.

Concepts

Question: How are animals classified?

1. Animals are classified according to structure.
2. All animals can be classified as invertebrates (without backbone) or vertebrates (with backbones).
3. Protozos, sponges, cuplike animals, and arthropods are invertebrates.
4. Fish, amphibians, reptiles, birds and mammals are vertebrate brates.
5. Mammals are the most complex of vertebrates and man is the most complex of mammals.

Question: How are plants classified?

1. Plants are classified according to similarities in structure.
2. Fungi, the simplest group of plants, depend on other living things for food; they have no roots, stems, leaves, seeds, or flowers.
3. Bacteria, yeast plants, rust, molds, and mushrooms are fungi.
4. Bacteria are one-celled fungi.
5. Yeast plants reproduce by budding.
6. Molds and mushrooms reproduce by spore formation.
7. Algae are the simplest group of plants that produce their own food.
8. Mosses, ferns, and seed plants are more complex groups of plants.
9. Two subgroups of seed plants are those that bear uncovered seeds and those that bear covered seeds.

A) Teaching Methods
B) Learning Activities

B) Dissect a chicken leg to note the function of the muscle system.

Have the children bring in pictures of all kinds of animals. Classify them according to structure.

Have a pupil report on coral, telling about coral reefs and islands made of coral skeletons.

Have a pupil report on trichina and hookworm and their affect on some people.

Start an aquarium.

Make three terraria - a swamp, woodland, and desert.

Take a walk to observe plants. Make a collection of plants.

Experiment with bread and mold to find out what it needs to grow. Be sure to look at it through a microprojector.

Examine mushroom and ferns for spores.

Examine algae under the microscope.

Find out why moss only grows on one side of a tree.

Make a collection of seeds. How are they different? Why do seed plants overproduce?

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

Concepts	A) Teaching Methods B) Learning Activities
Question: What are flowering plants? 1. Conifers are plants that produce seeds that grow on cones. 2. Flowering plants are plants that produce seeds with flowers. 3. Flowering plants have roots, stems, leaves, and flowers; each part has a particular function. 4. The root system of a plant holds the plant in the ground and serves as the structure through which water passes to other parts of the plant. 5. Plant stems support other parts of the plant and serve as transportation systems. 6. Leaves make food, take in sunlight and air, and release excess air. 7. The process by which plants with chlorophyll make food is called photosynthesis. 8. Flowers perform the function of reproduction. 9. Moisture, temperature, and air affect seed germination.	B) Draw a flowering plant and label the parts. What is the function of each part? You can demonstrate osmosis by putting Queen Anne's Lace in colored water. In a few hours it will be colored. Examine the woody tissue of a cross section of a tree. Make a leaf collection. How else can we identify trees? Examine a slice of a leaf under a microscope. Place a plant in a plastic bag to show that leaves release water. Condensation will appear inside the bag. Examine some flowers for their different parts. Draw a series of pictures that illustrate the life cycle of seed plants. Discuss how seeds travel.
Electricity Question: What is static electricity? 1. All objects are made of atoms which in turn are made of electrically-charged particles. 2. When an object becomes electrically charged, it either loses or gains negatively-charged electrons. 3. Static electrical charges do not move easily. 4. Like charges repel and unlike charges attract. 5. An electroscope will detect charged particles. 6. Static electricity can be dangerous.	A) Reading, discussing, observing, experimenting. B) Experiment with balloons to bring out that like charges repel and unlike charges attract. Have a pupil report on what type of materials conduct electrical charges. Have one report on what types of materials are insulators. Discuss the use of lightning rods on a building. Discuss where you should go in an electrical storm. Discuss the times the children have experienced static electric shocks.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
A) Magnets, Parker All About Electricity, Freeman The Wonder of Electricity, Ruchlis Electricity in Your Life First Electrical Book for Boys, Morgan Heat First Book of Electricity, Watts Science Year- World Book Encyclopedias	A) The children are aware of the uses and importance of electricity. They are aware of the dangers of electricity. They know the safety rules and use them. B) Use page 236 for review. Use page 238 for the test. Use a teacher made test.

Concepts

Question: How can electricity be produced?

1. An electric cell generates current electricity.
2. An electric cell is composed of two unlike materials and a chemical that will react with them.
3. Current electricity can flow through a wire, while static electricity is stationary.
4. When a magnet is moved near a wire, an electric current is produced.

Question: How does electricity flow?

1. Electricity flows easily through conductors and not through nonconductors or insulators.
2. In order for electricity to flow, there must be a complete curcuit.
3. Electricity flowing through the filament of a light bulb produces both heat and light.
4. The flow of current can be broken by removing part of the circuit.
5. When too much current is flowing through a house, the fuse or circuit breaker cuts off to remove part of the circuit.

Question: How is electricity used?

1. Electricity can be used for heat, light, and mechanical energy.
2. Wires through which large amounts of electricity flow can give off heat and light.
3. Electricity can be used to make powerful electromagnets.
4. A telegraph sends messages in Morse code by spurts of electric current over a wire.
5. Electricity can be dangerous. When using electricity, safety rules must be followed.

A) Teaching Methods
B) Learning Activities

B) Discuss the danger of static electricity and how one can prevent fires.
Make a list of all the uses of electric current.
Have the children make the simple electric battery described in the textbook on page 195.
Discuss the uses of different types of batteries.
Find out the uses of electromagnets.
Discuss why it is dangerous to have a radio over the bathtub while taking a bath.
Find out why birds don't get electrocuted when they sit on bare electrical wires.
Why doesn't your radio sound clear when you are near wires carrying a lot of elcctricity?
Have the children take apart a light socket to trace the circuit created when the light bulb is in the circuit. Break the glass of a light bulb and trace the circuit in the bulb.
Examine a good fuse and a burned out one.
Have a child bring in a toy that uses batteries. Have him trace the circuit. How does the motor work?
List electrical appliances using heat.
Bring in a waffle iron - observe the wires getting hot.
Make an electromagnet using a dry cell. Let the children do many experiments with it.
Bring out the safety rules.
Encourage them to examine their homes and community for violations.

	A) Printed			
	B) Audio Visual		A)	Expected Outcome
Resources	C) People	Evaluation	B)	Testing Program
	D) Places			

B) Filmstrips:
Static Electricity
How Electricity Helps Us
Magnets
Current Electricity
Electricity At Home
Overhead transparencies:
Magnetism and Electricity

C) Have an electrician or a fire safety officer talk to the class and give demonstrations of the workings of fuses and circuit breakers, their uses and safety measures.

Have a man from the telephone company to show the electric workings of the telephone.

A ham radio operator might bring his "rig" and explain the operation to the children.

D) Field trip:
To a power plant

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Concepts

Distances in Space

Question: What is meant by distance?

1. Distance is the amount of linear space between two places.
2. Distance may be measured in standard units of length.
3. The English and metric systems are two systems of measurement.
4. The metric system is based upon units of ten.
5. A standard is an agreed-upon unit of measurement upon which all other units are based.

Question: How can time be used to measure distance?

1. Distance can be measured in units of time and rate of motion.
2. The distance traveled is equal to the average rate of motion multiplied by time in motion.
3. Standards based on the speed of light are used for measuring great distances in space.
4. A light-year is the distance that light travels in one year.
5. Distances in space are very great.

A) Teaching Methods
B) Learning Activities

A) Reading, discussing, questioning, guiding, problem solving through investigation.

B) Do some measuring of objects in the room with a ruler and a yard stick.

Use a measuring tape to measure the room and playground.

Measure the desks with the hand-width method. Do the measurements differ? Bring out the importance of standard measurement.

Find out the work of the Bureau of Standards. Why are they necessary?

Have the pupils measure some distances in units of time. Example: length of school building, school yard, or from home to school

Be sure the children know what the word rate means.

Find out why we do not use "sound-years" away.

Make up problems for each other to do.

The idea of average rate should be stressed.

Provide the distance to certain stars and have the distance changed into light-years.

Measure some maps and figure the distance in miles.

How do they measure the distance from the earth to the sun?

Experiment with a protractor.

Find out what the words odometer, speedometer, and pedometer are and how we use them.

Work out the air miles between two cities and the road miles. The difference will prove interesting.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
A) Experiments in Optical Illusion, Beeler Fun With Astronomy, Freeman First Book Of Astronomy, Watts This Way to the Stars, Dutton Encyclopedias	A) The children are aware of the size of our universe.
B) Filmstrips: You and The Universe	B) Review using page 286. Test on page 287. Teacher made test.

Concepts	A) Teaching Methods B) Learning Activities
Question: How is distance in space measured? 1. A scale drawing is a useful tool in measuring distances in space. 2. Distances can be measured by sighting on an object from each end of a base line. 3. The longest base line for measuring distances to stars is the distance across the orbit of the earth. 4. Parallax is the apparent change in the position of an object when viewed from different places. 5. The farther away objects are, the less parallax effect is seen. 6. From the longest base line, only the nearest stars show a measurable parallax effect. 7. The difference between true brightness and apparent brightness helps astronomers measure distances of stars. 8. The slower a variable star changes brightness, the brighter the star is.	
The Milky Way and the Universe Question: What is the Milky Way? 1. The Milky Way galaxy is a huge system of stars, gas, and dust. 2. It is difficult for us to describe the Milky Way galaxy because the earth is inside it. 3. The sun and its planets are located on one arm of the Milky Way galaxy.	A) Reading, discussing, observing, researching. B) Have the more able children report on the modern-day astronomers. Find the meaning of the word galaxy. Try to get the distance concept over to the children as to how far our nearest star is. Draw pictures of the Milky Way galaxy showing our sun and the planets of our solar system.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
A) Giant Golden Book of Astronomy Find the Constellations Dipper Full of Stars The Adventure Book of Stars Point to the Stars B) If a telescope is available, set it up and view the sky at night. A lot of parents would be interested too. Filmstrips: Astronomy The Sky The Starry Universe	A) The children show an appreciation for the earth. They show an interest in the sky and use their eyes. B) Review on page 334. Test on page 335. Do suggestion in teacher's book on page 334 instead of a test on this unit.

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Concepts

Question: Where are you in the universe?
1. The Milky Way is a spiral galaxy with a thick central core, a thinner disk, and spiral arms containing dust in which new stars are formed.
2. Astronomers learn many things about the stars by examining the light coming from them; the light differs in objects moving toward us and away from us.
3. There is a possibility that life as we know it exists elsewhere in the universe.

Question: What is the extent of the universe?
1. The size and age of the universe can be inferred from such evidences as the speed of recession of galaxies and their distance from the earth, and from radioactive dating of rocks.
2. The two main concepts describing the beginning of the universe are the Big Bang Theory and the Steady-State Theory.
3. Astronomers will be better able to study the universe from a space platform outside the earth's interfering atmospheric conditions.

A) Teaching Methods
B) Learning Activities

B) Look up the word prism. Bring one to school if possible. Let the children experiment with sun shining through it.

Review the conditions necessary for life on the earth. Do you think there is life on another planet? Why or why not?

Do research on the galaxy of Andromeda.

Report on Edwin Hubble as to who he was and what he did.

Find out how to make a simple spectroscope in a "how-to-do-it" book.

Have some pupils find out what particles leave a radioactive material when it changes to another material.

Review meteorites.

Look up the meaning of the words cosmology and cosmogony.

Build and label models of various types of satellites.

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Evaluation
A) Expected Outcome
B) Testing Program

D) Field trip:
Planetarium - Natural History Museum.

Concepts

Question: What are constellations?

1. The constellations are groups of stars which seem to be arranged in patterns.
2. During the night, the stars seem to move across the sky from east to west; this apparent motion is due to the earth's rotation.
3. Different constellations are seen at different times of the year because of the earth's revolution around the sun.
4. Most of the best-known constellations appear along the ecliptic, which is the apparent path of the sun through the sky during the year.

A) Teaching Methods
B) Learning Activities

B) Look up the names of the more common constellations, what the name means and the arrangement of stars. Make a large picture of them.

Observe the Big Dipper - draw the picture of both Dippers and Polaris.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

READING COMMUNITY SCHOOLS

CURRICULUM GUIDE

SCIENCE

MIDDLE

The following texts have been adopted to further our science programs in The Reading Community Middle School:

Name of Text	Year Level	Company	Quantity
Investigating in Science	6	American Book Co.	
Science	6	Silver Burdett	35
Science a Modern Approach	6	Holt Rinehart Winston	30
Science for Today and Tomorrow	6	D. C. Heath & Co.	35
Science for Tomorrow's World	6	McMillan	35
Today's Basic Science	6	Harper Row	45
Man Matter and Energy	7	Holt Rinehart Winston	35
Earth Space and Environment	8	Holt Rinehart Winston	35
Investigating Matter and Energy	6-7-8	Addison Wesley	60
Physical Science (A laboratory approach)	6-7-8	Addison Wesley	
Energy and the Atom	7-8	Harper Row	45
Laboratory Text #3	7-8	D. C. Heath & Co.	30
Life and the Molecule	7-8	Harper Row	45
Our Planet in Space	7-8	Harper Row	30
Patterns and Processes of Science #1	7-8	D. C. Heath & Co.	35
Patterns and Processes of Science #2	7-8	D. C. Heath & Co.	30

SCIENCE - 6TH YEAR - Jacobsen, Willard J., Lauby, Cecilia J. and Konicek, Richard D., Investigating in Science, American Book Co., New York, 1965

- Light And Heat
  - What is the Nature of Light?
  - What are Some Properties of Light?
  - What is Heat?
  - How does Heat Affect Matter?
- Energy From The Sun
  - What is the Sun?
  - What is the Source of Solar Energy?
  - How is Solar Energy Controlled?
- Insects And Senses
  - What are Some Physical Characteristics of Insects?
  - How Do Animals Sense their World?
- The Ocean
  - How is the Ocean Studied?
  - What is the Ocean Like?
  - What Kinds of Life Exist in the Ocean?
- Exploring the Universe
  - How is the Universe Studies?
  - Is there Intelligent Life Elsewhere in the Universe?
  - How Can Men Travel to Distant Stars?
- The Atom and Nuclear Energy
  - What is the Structure of the Atom?
  - How is Nuclear Energy Obtained?
  - How is Nuclear Energy Used?

Concepts

Investigating in Science

Light and Heat

A. Introduction

B. What is the Nature of Light?
   1. Several theories about the nature of light have been developed. They are used to explain the behavior of light.
   2. According to the particle theory, light is made up of tiny particles that move at great speeds.
   3. According to the wave theory, light energy is though of as vibrations.
   4. According to a theory that combines the particle and wave theories, light energy is made up of photons that travel in waves.
   5. Light appears to travel in straight lines through space.
   6. Light is reflected by nearly all surfaces: smooth surfaces cause diffuse reflection.
   7. Because light travels at different speeds through different substances, refraction occurs.
   8. Diffraction occurs when light passes through an opening.

C. What are Some Properties of Light?
   1. Visible and invisible light are forms of radiant energy.
   2. Light travels at a constant speed. A light-year is the distance light travels in one year.
   3. A prism will separate white light into colors of the spectrum.
   4. The eye is an organ which receives light, forms images, and transmits the images to the brain.

A) Illustration
   1. Demonstrate regular and diffuse reflection
   2. Waves
   3. Properties of light
   4. Heat
   5. Properties of heat

B) 1. Observation of light traveling in straight lines; through a pinhole, and reflection
   2. Observation of heat

S m 3

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Learning Center
A) Let's Experiment
Beginning Science
Light and Color

Reference:
Investigating in Science,
Jacobsen, et. al.
American, 1965. pp. G22, G23, G24

Evaluation
A) Expected Outcome
B) Testing Program

A)
1. Properties of light are best explained through the wave theory, while other properties of light are best explained by the particle theory.
2. Ways of releasing heat.
3. Ways in which heat affects matter.

B) Student
1. Investigating in Science,
   Jacobsen, et. al.
   American, 1965. p. Gv
2. What aspect am I interested in?
3. How will I find out?
4. What are some possible answers?
5. What do I want to find out?
6. What are my conclusions?

Teacher
1. Observe student skills in experimentation.
2. Accuracy of observations.
3. Competency in recording data.
4. Judgments in interpreting data.
5. Ability to formulate pertinent data.
6. Clarity and accuracy in stating conclusions.
7. Verification of findings.
8. Note capacity for self-evaluation.
9. Student's efforts to convey what he has learned to others.

Concepts	A) Teaching Methods B) Learning Activities
5. Convex lenses cause light to converge; concave lenses cause light to diverge. 6. Light can pass through some materials but not others. D. What is Heat? 1. Sources of heat are chemical energy, mechanical energy, and nuclear energy. 2. The caloric theory of heat, which suggests that heat is a fluid substance, was disproved by Count Rumford. 3. Heat is related to the total kinetic energy of molecules in a substance. 4. Temperature is a measure of the average kinetic energy of molecules in a substance. 5. Most thermometers measure heat by the principle of expansion; most thermometers use the Fahrenheit or Celsius scales.	

Resources
- A) Printed
- B) Audio Visual
- C) People
- D) Places

Evaluation
- A) Expected Outcome
- B) Testing Program

S m 6

Concepts

Energy From The Sun

A. Introduction

B. What is the Sun

1. The sun is the most important star to the earth.
2. The sun is one of about 100 bilion stars traveling around the center of the Milky Way.
3. In relation to other stars, the sun is a medium-sized star and average in temperature.
4. The sun is in a gaseous state.
5. The chemical elements on the sun can be detected by a spectroscope.
6. Some of the major features of the sun are the photosphere, chromosphere, prominences, corona, sunspots, and solar flares.
7. Particles emitted from the sun can disrupt radio communications on the earth; some may be trapped in the magnetic field of the earth, forming the magnetosphere.

C. How is Solar Energy Controlled?

1. Solar energy, concentrated through photosynthesis, is released through the burning of fuels.
2. Solar energy can be concentrated by using concave mirrors and convex lenses; this energy may be used in solar furnaces and heaters.
3. Solar energy can be used to convert seawater to fresh water by using the principles of the greenhouse effect and high heat absorption by dark materials.
4. Solar energy can be converted into electricity with solar cells which use silicon.

A) Teaching Methods
B) Learning Activities

A) Discription, Illustration, Demonstration
1. Knowledge of the sun.
2. Solar heat.
3. Theories of origin of the sun.
4. Solar eclipse.

B) 1. Observations and investigation of solar eclipses, spectra of elements, brightness of light, greenhouse effect, and absorption of solar energy.

A) Printed
B) Audio Visual
Resources C) People
D) Places

Learning Center
A) The Wonders of Space
Light and Color
Our Earth
Insects
Man and Insects
Field Book of Insects
Planets, Stars, and Space, Chamberlain

Reference:
Jacobsen, et. al.
pp. G42, G43

A) Expected Outcome
Evaluation B) Testing Program

A)
1. The place of the sun in the universe and how it relates to other stars.
2. Source of heat as a nuclear reaction.
3. Uses of solar energy and its control by man
4. The origin and order of the universe.

B) (See Evaluation this guide "Light & Heat")

Concepts

Insects And Senses

A. Introduction

B. What Are Some Physical Characteristics Of Insects?
   1. Insects are grouped as arthropods because they have jointed legs and exoskeletons.
   2. All insects have three pairs of legs.
   3. All insects have one pair of antennae.
   4. All insects have three parts: head, thorax, and abdomen.
   5. The mouth parts of insects determine what insects eat.
   6. Many insects undergo metamorphosis as they develop from eggs to adults.
   7. Insects are classified on the basis of their structure.
   8. Insects have many self-protecting adaptations.
   9. Some insects are beneficial to man; others are harmful.
   10. Entomology is the science dealing with the study of insects.

C. How Do Animals Sense Their World?
   1. All animals have some type of nervous system.
   2. The nervous system controls body movements and the work of important organs.
   3. Reflex actions are those which require no decision by the brain.
   4. The nervous system in man includes the central nervous system and the autonomic nervous system.
   5. The eye is the organ of sight; the ear, the main organ of hearing; the tongue, the main organ of taste; the nose, the main organ of smell; and nerve endings in the skin pick up the sensations of heat, cold, pain, pressure, and touch.

A) Teaching Methods
B) Learning Activities

A) Discussion, Illustration, Display and Demonstration
   1. Insects and their physical characteristics, their habitats, life cycles, and effects upon man.
   2. Nervous system of man and insects.

B) Collecting and observing insects

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Learning Center
A) Insects
Field Book of Insects
The Lives of Animals

Reference:
Jacobsen, _et. al._
pp. G75, G76

Evaluation
A) Expected Outcome
B) Testing Program

A) 1. Insect characteristics
2. A comparison and contrast between human sight and insect sight.

B) (See evaluation this guide "Light & Heat")

Concepts

The Ocean
A. Introduction
B. How is the Ocean Studied?
  1. Oceanography deals with the study of the ocean and involves several basic sciences.
  2. Echo sounding is used to determine ocean depths.
  3. Pressure-resistant thermometers and bathythermographs are used to obtain temperatures of ocean water.
  4. Bottom samplers, sound waves, and photography are used to study the ocean bottom.
  5. The bathysphere and bathyscaphe are deep-sea exploration "laboratories."
  6. The bathyscaphe operates on the basis of Archimedes' principle which states that a body immersed in a liquid is buoyed up by a force equal to the weight of the liquid it displaces.
  7. An object that is less dense than water will float in water; one that is more dense than water will sink.
C. What is the Ocean Like?
  1. The crust of the earth is thinner under the floor of the ocean than under land areas.
  2. The three main parts of the ocean floor are the continental shelf, the continental slope, and the basin.
  3. Rising from the basin are volcanoes and huge mountains.
  4. Great cracks in the basin are trenches, the deepest points on the earth.

A) Teaching Methods
B) Learning Activities

A) Introduction; Illustrate
  1. Hydrometer
  2. Project Mohole
  3. Influence of the sun and the moon on ocean tides
  4. Content of seawater
  5. Saltwater aquarium

B) Individual investigation

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) Oceanography The Ocean Laboratory, Spilhaus	A) 1. Adventures of oceanography B) (See evaluation this guide "Light & Heat)
Reference: Jacobsen, et. al. pp. G96, G97, G98	

A) Teaching Methods
B) Learning Activities

Concepts

5. The ocean floor is made up of basalt. Continents lie on bases of granite.
6. Winds, water temperature, rotation of the earth, and deflection by continents influence ocean current patterns.
7. Tides are caused by many forces, the most important being gravitational attraction of the moon on the earth.
8. The motion of a wave changes when it approaches a shore.
9. There are many minerals, microscopic plants, and animals in seawater.
10. The sea is slowly increasing its salt content.

D. What Kind of Life Exist in the Ocean?
   1. Plankton, which are tiny marine plants and animals, begin a series called the food chain.
   2. Life in the ocean is possible because it contains the necessary water, oxygen, carbon dioxide, and minerals and because of these properties of water: buoyancy and solvency.
   3. Life in the ocean varies from small to large and from the simple to the complex.
   4. Among the groups of animals living in the ocean are sponges, coelenterates, mollusks, arthropods, sea stars, fish, and mammals.
   5. Many animals which live in the ocean are beneficial to man.
   6. Some of the plants which grow in the ocean are single- and multiple-celled algae and seed plants.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

Concepts

Exploring The Universe

A. Introduction

B. How is the Universe Studied?
  1. Electromagnetic energy, given off by all bodies in the universe, travels through space in the form of waves.
  2. The type of electromagnetic energy may be determined by the wavelength; the different types include cosmic, gamma, ultraviolet, and X rays and microwaves, radio waves, and visible light.
  3. Optical telescopes, which gather and concentrate light, are of mainly two types: refractors using lenses and reflectors using mirrors.
  4. Optical telescopes are limited in their use by changing atmospheric conditions and interstellar dust.
  5. Radio telescopes concentrate radio waves the way optical telescopes concentrate light; however, since radio waves can penetrate interstellar dust, they can be used to study hitherto unexplored regions of the universe.

C. Is There Intelligent Life Elsewhere in the Universe?
  1. Certain conditions are necessary for the survival of life: water in liquid form; certain chemicals, particularly carbon, hydrogen, and oxygen; light; and proper temperatures.
  2. The common characteristics of all living things include ability to react to stimuli, to reproduce, to grow, to adapt to environment, and to die.

A) Teaching Methods
B) Learning Activities

A) Explanation, Discussion, Illustration
  1. Waves
  2. Radiometer
  3. Electromagnetic spectrum
  4. Reflection
  5. Conditions necessary for plant life

B) Reading of scientific journals for theories.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

Learning Center
A) Electricity

A) Electromagnetic energy

B) (See evaluation this guide "Light & Heat")

Reference:
Jacobsen, et. al.
pp. G115, G116, G117

Concepts

A) Teaching Methods
B) Learning Activities

3. If life exists elsewhere in the universe, it probably would be similar to life on the earth; therefore, similar conditions would be necessary for life elsewhere.
4. There is a good possibility that intelligent life exists elsewhere in the universe.
5. Intelligent life elsewhere in the universe probably could best be detected by radio communication.

D. How Can Men Travel to Distant Stars?
   1. According to Einstein's theory of relativity, all motion is relative to some given observer, object, or point.
   2. The velocity of light is constant, independent of the direction or the velocity of motion of an observer.
   3. As an object moves faster, it begins to shrink in the direction in which it is moving; this occurrence is noticeable only as objects approach the speed of light.

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Evaluation
A) Expected Outcome
B) Testing Program

Concepts

The Atom And Nuclear Energy

A. Introduction

B. What is the Structure of the Atom?
  1. Most of an atom is space with electrons moving about a dense nucleus of protons and neutrons.
  2. Scientists used the cathode-ray tube to discover the nature of the proton and electron.
  3. Rutherford's experiments helped him determine the size of the nucleus.
  4. Atoms of different elements differ in the number of particles in the nuclei and the number of electrons.
  5. Symbols can be used to represent the atomic number and the atomic mass.
  6. Neutrons are good "bullets" for striking atomic nuclei.
  7. Isotopes are chemically alike elements with different masses.

C. How is Nuclear Energy Obtained?
  1. Radioactive elements may give off three kinds of rays.
  2. Geiger counters can detect these rays.
  3. Scientists can change many elements into others.
  4. Particle accelerators "shoot" atomic particles at nuclei of atoms.
  5. Uranium-235 can split and release a lot of energy when hit by a neutron.
  6. U-235 is separated from U-238 by diffusion.
  7. A critical size of U-235 is necessary for a chain reaction in a fission bomb or a nuclear reactor.

A) Teaching Methods
B) Learning Activities

A) Discussion, Historical Approach, Models
  1. Atoms
  2. Static electricity
  3. Nuclear energy
  4. Atomic disintegration
  5. Geiger counter

B) 1. Examining achievements from a historic standpoint.
  2. Construction of models.

A) Printed
B) Audio Visual
Resources C) People
D) Places

Learning Center
A) Atomic Energy
Electricity
Atoms, Energy, and Machines, McCormick

Reference:
Jacobsen, et. al.
pp. G137, G138

A) Expected Outcome
Evaluation B) Testing Program

A) 1. Nature of the atom.
2. Methods of obtaining nuclear energy.
3. Uses of nuclear energy.

B) (See evaluation this guide "Light & Heat")

Concepts

A) Teaching Methods
B) Learning Activities

D. How is Nuclear Energy Used?

1. The energy of the atom bomb comes from matter being changed into energy.
2. In nuclear fusion atoms combine to form larger atoms.
3. There are different types of nuclear reactors that convert nuclear energy to other forms of energy.
4. Radioisotopes are molecules that contin certain radioactive atoms.
5. Radioactive atoms can be traced with a Geiger counter.
6. Radioisotopes can be used to trace the path of molecules in animals and plants.
7. Radioisotopes have many uses in industry.
8. Carbon-14 can be used to date ancient material and to change the characteristics of plants.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

OVERVIEW

Navarra, Garone,
Energy and the Atom
The Physical Sciences
Harper & Row, New York, 1966

Interaction, A Process of Science
  Interacting and Learning
The Elements of Chemistry
  The Structure of the Atom
  Classifying the Elements
  The Making of Molecules
Machines and Energy
  Work and Energy
  Machines
  Magnetism and Electricity
The Biophysics of Sound
  Acoustics, The Study of Sound
  Producing Sound
  Hearing Sound
The Energy of Light
  The Visible Spectrum
  Photosynthesis
The Energy of the Atom
  Radioactivity
  Reactors and Accelerators
Electronics
  Moving Electrons
  The Electronic Computer
  Inside the Computer
From Atmosphere to Space
  Supersonic Flight
  Rockets and Rocketry
  Satellites in Orbit

Concepts	A) Teaching Methods B) Learning Activities
Energy and the Atom A. Introduction B. Interacting Astromomers 1. Ptolemy believed that the sun and the planets revolved around the earth. 2. Copernicus established the accepted belief that the earth revolves around the sun. 3. Interactions among astromoners have helped us to understand the solar system. C. Your Own Interaction 1. Interaction is a give-and-take experience between two persons and the conditions of his environment. 2. The face-and-point method is a system for locating stars and planets. D. Exploring the Sky 1. An observer interacts with the stars and planets when he studies the nighttime sky. 2. The stars and planets are in motion; the sky changes from month to month.	A) Discussion, Reviews Introduction, Interaction, Challenge 1. Observation of the night time sky. 2. Compare Ptolemaic System with the Copernical System. 3. Man of Science biographies of Ptolemy and Copernicus 4. Learning Packet (Teacher prepared) B) Reports on an Interaction Sky watch observation
The Elements of Chemistry A. Introduction B. From Dalton to Bohr 1. All matter is made up of atoms. 2. Every atom has the same basic structure consisting of a nucleus and orbital electrons. 3. The atoms of different elements differ from one another in the number of protons and electrons they contain. 4. An Atom is three-dimensional; it has depth and volume, like a ball. 5. A charged atom is known as an ion; an atom becomes a positive ion when it loses an electron; it becomes a negative ion when it gains an electron.	A) Discussion, Illustration, Explanation, Impression. Comparison 1. Structure of the Atom. 2. Dalton's Contribution to science. 3. Electron arrangement 4. Diagrams of H, He, and C atoms. 5. Learning packet (Teacher prepared) B) 1. Interaction 2. Observation of a mass spectograph 3. Diagram of Atoms.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) Printed Planets, Stars, and Space Chamberlain Sun and its Family Galileo and The Magic Numbers Rosen Modern Physical Science Brooks and Tracy, Holt, New York, 1957 The Physical Sciences Eby, Wauch; Welch, Ginn 1950 Reference: Navarra, et. al. pp.15,16,17.	Objectives A) Interaction among stars Testing Program Student 1. What aspect am I interested in? 2. What do I want to find out? 3. How will I find out? 4. What are some possible answers? 5. What are my conclusions? Teacher 1. Manipulation of equipment 2. Note the accuracy of observations 3. Note capacity for self-evaluation
Learning Center A) Printed The Story of Atomic Energy Fermi. Random, 1961 Handbook of Chemistry, Lange, Handbook Publishers 1952 First Chemistry Book for Boys and Girls Scribner, 1950 New Chemistry Fun with Chemistry, Freeman. Random, 1962	Objectives A) Use of mass spectograph Testing Program Student (See Evaluation this guide "Interaction and Learning")

Concepts	A) Teaching Methods B) Learning Activities
C. Electron Shells 1. A flow of electrons gives rise to an electric current. 2. The electrons in an atom are arranged on energy levels and an energy sublevel. 3. An electron gives off energy when it drops from a higher energy level to a lower energy level 4. Scientists can identify materials by means of spectrum analysis. D. The Nucleus 1. Protons and neutrons are found within the nucleus of the atom. 2. Isotopes are different types of atoms of the same element. 3. An isotope of an element differs from other isotopes of the same element only in the number of neutrons it contains and in atomic weight.	
Classifying the Elements A. Introduction B. The Periodic Table 1. The Periodic Table of the elements is an orderly arrangement of the 103 chemical elements known to scientists. 2. All the elements are arranged in groups and periods within the Periodic Table. 3. Elements belonging to the same group have similar properties. C. Periodic Classification 1. The Periodic Table is made up of three short periods and four long periods. 2. The properties of an element are determined to a large extent by its electron configuration. 3. Similar properties among elements recur peridically; thus, the elements fall into groups within the Periodic Table.	A) Discussion, Suggestion 1. Contribution of chemistry to our way of living 2. Interpret the Periodic Table of elements 3. Electron configuration 4. Learning Packet(Teacher Prepared) B) Group activity to exchange ideas with each other Ingenuity and resourcefulness to depict elements Writing of electron configuration Observation of the Periodic Table

A) Printed
B) Audio Visual
Resources C) People
D) Places

Exploring Chemistry,
Gallant, Garden City, 1958
Giant Molecules

Reference
Navarra, et.al.
pp. 36,37, 38

Learning Center
A) Printed
Atoms (the core of all matter)
Korn, Golden Press, 1961

A) Expected Outcome
Evaluation B) Testing Program

Teacher
1. Note clarity and accuracy
2. Accuracy of observation.

Objectives
A) Use of Periodic Table of Elements
B) Testing Program Student
(See Evaluation this guide "Interaction and Learning")
Testing Program Teacher
1. Note willingness to check results against the findings of reliable sources
2. Recognize the total design of the investigation

Concepts	A) Teaching Methods B) Learning Activities
D. Groups and Families 1. There are nine groups of elements; all groups of elements except Group V111 and Group 0 contain subgroups. 2. All the elements withnn a subgroup have similar properties. 3. Elements with few electrons in their outer shells are usually the most active. 4. An active element combines readily with other elements; it frequently is involved in chemical reactions. E. Development of the Table 1. Mendeleyev devised the Periodic Table of the Elements. 2. Moseley improved the Periodic Table of the Elements by arranging the elememts according to their atomic numbers.	
The Making of Molecules A. Introduction B. Again, the Elements 1. Metals combine with nonmetals to form oxides, chlorides, and sulfides. 2. Metals tend to lose electrons when they combine with other elements; nonmetals tend to gain electrons when they combine. 3. In general, the inert gases are inactive, although they can enter into reactions under certain conditions. C. Chemical Bonding 1. A molecule is formed when two or more atoms are linked together. 2. A compound is a substance consisting of two or more elements chemically combined. 3. The smallest whole unit of a compound is a molecule. 4. A structural formula shows how the atoms of a molecule are linked together. 5. A chemical equation shows the results of a chemical reaction. 6. Valence is the combining power of an atom. 7. Electron-dot formulas show the number of valence electrons in the atom.	A) Discussion, Advise, Drill, Suggestion, Review, Quiz 1. Chemical formulas 2. Chemical bonding and chemical compounds 3. Metals, non-metals, and inert gases 4. Chemical symbols 5. Acids and Bases 6. Learning Packet (Teacher Prepared) B) Techniques of writing structural formulas Observation of characteristics of compounds.

A) Printed
B) Audio Visual
Resources C) People
D) Places

Reference:
Navarra, *et.al.*
pp. 52,53

A) Expected Outcome
Evaluation B) Testing Program

3. Appraise efforts to convey what he has learned to others
4. Assess skills of communication

Objectives
A) Development of synthetic fibers

Testing Program
B) Student
(See evaluation this guide "Interaction and Learning")
Teacher
1. Note the accuracy in recording data.
2. Assess ability in formulating pertinent data

Concepts

D. Kinds of Bonds
   1. Ionic bonding is the linking of ions; one ion loses an electron and the other gains an electron.
   2. The ions of ionic compounds separate when the compound dissolves.
   3. The full symbol for an ion shows its negative valence or positive valence.
   4. The atoms involved in covalent bonding share electrons.

E. Kinds of Compounds
   1. Inorganic chemistry is largely a study of ionic compounds; among the ionic compounds are acids, bases, and salts.
   2. Organic chemistry is primarily a study of carbon compounds together.

Machines and Energy

Work and Energy

A. Introduction

B. Force and Motion
   1. Force is any influence that produces motion or that prevents motion.
   2. A body at rest will remain at rest unless an outside force acts upon it; a body in motion will remain in motion unless an outside force acts upon it.
   3, The force on a mass is directly proportional to the acceleration of the mass.
   4. For every action thereis an equal and opposite reaction.

C. Work
   1. Work is the operation of a force through a distance.
   2. Power is the rate of doing work.

D. Energy
   1. Energy is the ability to do work.
   2. There are two basic types of energy: kinetic energy and potential energy.

A) Teaching Methods
B) Learning Activities

A) Explanation; Guide students in making quantitative measurements, Discussion
   1. Work, force, and energy
   2. Newton's first Law of Motion
   3. Mass and weight
   4. Learning Packet (Teacher Prepared)

B) 1. Perception of what it means to be able to do work.
   2. Enumeration of examples of work, force, and energy.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Teaching Methods
Evaluation B) Testing Pcogram

Reference
Navarra, *et.al.*
pp. 68,69,70

Learning Center
A) Printed
  Atoms, Energy, and Machines
    McCormick
  Wonders of Physics
    Adler
  Simple Machines and How they Work
    Sharp. Random House, 1959

Reference
Navarra, *et.al.*
pp. 86,87

Objectives
A) Energy in a model pile driver

Testing Progran
B) Student
  (See Evaluation this guide "Interaction and Learning")
  Teacher
  1. Note judgments in interpreting data
  2. Assess the application of findings to appropriate situations
  3. Note willingness to check results against findings of reliable authorities.

Concepts

Machines

A. Introduction

B. Six Simple Machines
   1. A machine is a device that helps to do work.
   2. There are six simple machines: the lever, pulley, wheel and axle, inclined plane, wedge, and screw.
   3. Some machines change the magnitude of a force; other machines change the direction of a force.

C. Mechanical Advantage
   1. Effort is the force applied to a machine.
   2. Resistance is the force a machine exerts on an object being moved.
   3. Mechanical advantage is the ratio of the resistance force to the effort force; mechanical advantage can also express the ratio of effort distance to resistance distance.
   4. The ratio of resistance force to effort force is the actual mechanical advantage.
   5. The ratio of effort distance to ' resistance distance is the ideal mechanical advantage.
   6. The efficiency of a machine is the ratio of its actual mechanical advantage to its ideal mechanical advantage.

D. Internal Combustion
   1. The fuel is burned internally in an internal- combustion engine.
   2. The pistons and cylinders are important parts of a gasoline engine.
   3. The pistons in the gasoline engine operate on a four-stroke cycle; intake, compression, power and exhaust.

A) Teaching Methods
B) Learning Activities

A)Discussion, Demonstration
   1. Archimedes
   2. Three kinds of levers
   3. Effort and Resistance
   4. Internal Combustion engine
   5. Learning Packet (Teacher Prepared)

B) 1. Concentration on most essential units or components
   2. Reports on choice of machine
   3. Identification of machines

A) Printed
B) Audio Visual
Resources C) People
D) Places

Learning Center
A) Printed
Atoms, Energy, and Machines
McCormick
Machines
Parker. Harper & Row, 1962
Simple Machines and How they Work
Sharp. Random House, 1959

Reference
Navarra et.al.
pp. 101

A) Teaching Methods
Evaluation B) Testing Program

Objectives
A) Simple complex machines

Testing Program
B) Student
(See Evaluation this guide
"Interaction and Learning")

Teacher
1. To recognize the total design of the investigation
2. Assess Competency in recording data

Concepts

Magnetism and Electricity

A. Introduction

B. Magnets

1. A magnet has a north-seeking pole and a south-seeking pole.
2. The poles of a magnet are the regions of strongest attraction.
3. Like poles repel and unlike poles attract; this is the law of magnets.
4. A magnetic field surrounds every magnet.

C. Electromagnetism

1. A magnetic field surrounds a wire through which an electric current is moving.
2. You can determine the direction of a magnetic field by applying the left-hand rule.

D. Electromagnetic Induction

1. Electricity produces magnetism; magnetism produces electricity.
2. A magnetic field induces a current in a conductor when the conductor moves through the magnetic field or when the magnetic field moves within the vicinity of the conductor.

E. Measuring Electric Current

1. The "Pressure" of an electric current is known as voltage.
2. A volt is a unit of measurement for voltage.
3. The ampere is a unit for measuring the flow rate of an electric current.
4. All conductors resist the flow of electrons to some extent; this opposition of electron flow is known as resistance.
5. The ohm is a unit for measuring resistance.
6. Ohm's law expresses the relationship between volts, amperes, and resistance.

A) Teaching Methods
B) Learning Activities

A) Demonstration, Discussion Explanation; Quiz

1. Polarity of magnets
2. Energy
3. Relationship between magnetism and electricity
4. Electromagnetic induction
5. Units of measurement in electricity
6. Learning Packet (Teacher Prepared)

B) 1. Compiling of a table in a class project
2. Reading of an electric meter

Resources
- A) Printed
- B) Audio Visual
- C) People
- D) Places

Learning Center

A) Printed

All About Electricity
Urbanowich, Random House, 1957
Junior Science Book of Electricity
Fervolo
Magnets
Fervolo
Magnetism
Yates, Harper&Row, 1959
Understanding Electronics
Lewellen, Crowell, 1957
Lightning and Thunder,
Zim, Morrow, 1952

Evaluation
- A) Expected Outcome
- B) Testing Program

Objectives

A) Electric appliances in the home

Testing Program

B) Students

(see Evaluation this guide "Interaction and Learning")

Teacher

1. Appraise the students efforts convey what he has learned to others
2. Note the extent of open-mindedness as to the variety of other possibilities

Concepts	A) Teaching Methods B) Learning Activities
F. Magnetism 1. Magnetism is a form of energy 2. Some materials are magnetic materials; others are non-magnetic 3. The electron-spin theory is one explanation of magnetism 4. Atoms form magnetic domains within magnetic materials	
The Biophysics of Sound	
Acoustics, The Study of Sound	
A. Introduction	
B. What is Sound? 1. There are two definitions of sound; a physiological definition and a physical definition. 2. The physiological definition of sound requires: a vibration, a medium through which the vibrations moves, and a receiving instrument which picks up the vibration. 3. According to the physical definition sound is a disturbance in matter.	A) Play excerpts from Beethoven's Symphony and Brahm's Symphony Review; 1. Sound 2. Vibrations 3. Transverse waves and longitudinal waves 4. Learning Packet(Teacher Prepared) B) 1. Identification of various instruments producing the sound 2. Comparison of sounds
C. Vibrations 1. A vibration is a disturbance in matter; it is a movement within air, wood, steel, or some other medium. 2. Elasticity and momentum give rise to vibration. 3. A vibration produces sound. 4. Among the properties of a vibrating object are its frequency and amplitude. 5. A sound can have a high pitch or a low pitch; pitch is a psychological interpretation.	
D. Wave Motion 1. A vibrating object can cause another to vibrate. 2. The pushing of molecules with air or some other medium gives rise to a sound wave. 3. A sound wave is an orderly sequence of compressed molecules and rarefied molecules; compression and rarefaction set up sound waves.	

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Evaluation
A) Teaching Methods
B) Testing Program

Reference
Navarra et.al.
pp.114,115

Learning Center
A) Printed
The World of Sound Recording
Murray
Sound
Anderson, Garrard, 1962
Sound
Parker, Harper&Row, 1961
Animal Sounds
Mason, Morrow, 1948

B) Audio Visual
Meet the instruments of the Symphony Orchestra 2 color filmstrips
1 12 in. LP recording
Instruments of the Band and Orchestra
Films
The Brasses B&W
The Woodwinds B&W
The Percussions B&W
The Strings B&W

Reference
Navarra, et.al.
pp. 131, 132

Objectives
A) 1. Interrelationships of biology to the physical sciences
2. Phenomena of echoes

Testing Program
B) Student
(See Evaluation this guide "Interaction and Learning")
Teacher
1. Recognize the total design of the investigation
2. Note the accuracy of observations
3. Note judgments in interpreting data
4. Clarity and accuracy in stating conclusions
5. Assess ability to predict in terms of other pertinent problems

S m 37

Concepts

E. The Sound Wave
  1. In a transverse wave, the particles of the medium vibrate at right angles to the wave itself.
  2. A longitudinal wave moves in the same direction in which particles within the medium are vibrating.
  3. A sound wave is a longitudinal wave.

Producing Sound
A. Introduction
B. Strings and Sounds
  1. Elasticity and momentum can set a string to vibrating.
  2. A string produces a sound wave when it vibrates.
  3. One kind of wave is known as a standing wave; a node and an antinode are two important parts of a standing wave.
  4. A stretched string produces a tone known as a fundamental when it vibrates as a whole.
  5. A string can vibrate as a whole and in segments simultaneously, producing a blend of tone.
C. Vibrating Air Columns
  1. A parcel of air had elasticity.
  2. Elasticity and momentum can set a column of air to vibrating.
  3. A wave within an air column consists of a loop. a node, and an antinode.
  4. A vibrating column of air produces a sound wave.
D. Percussion and Sound
  1. A percussion instrument produces a sound when it is struck; among the percussion instruments are drums, bells, and cymbals.
  2. A percussion instrument produces irregular sound waves.

A) Teaching Methods
B) Learning Activities

A) Demonstration of Classroom, band Discussion, Comparison
  1. Waves produced by strings
  2. Physics of a loop. node, and antinode
  3. Production of Sound
  4. Learning Packet (Teacher Prepared)

B) 1. Investigation of waves and wave motion
  2. Anatomy of the larynx
  3. Observation of vocal organs

A) Printed
B) Audio Visual
Resources C) People
D) Places

Learning Center
A)Printed
World of Sound Recording
Murray
HiFi
Eisenberg, Random House, 1958
Animal Sounds
Mason, Morrow, 1948

B) Audio Visual
Meet the instruments of the Symphony Orchestra
2 color filmstrips
1 12 in. LP record
Instruments of the band and Orchestra
Films;
The Brasses B&W
The Woodwinds B&W
The Strings B&W
The Percussions B&W

A) Expected Outcome
Evaluation B) Testing Program

Objectives
A) Sounds o f Musical instruments

Testing Program
B) Student
(See Evaluation this guide "Interaction and Learning")

Teacher
1. The purpose of the investigation
2. Note the accuracy of observations
3. Assess the verification of findings

Concepts	A) Teaching Methods B) Learning Activities
E. Sound from the Voice 1. A set of vibrating strings (the vocal cords) produces the sound of your voice. 2. The vocal cords consist of two fibrous bands stretched across the voice box, or larynx. 3. The voice box is partly like a wind instrument and partly like a string instrument; the vocal cords vibrate like strings; a column of air within the voice box vibrates along with the vocal cords. 4. The vocal organs consist of the larynx, lungs, windpipe, throat, nose and mouth. 5. The tone of one voice differs from the tone of another voice. F. Animal Sounds 1. Animals have voice boxes and are able to make sounds. 2. The sounds of animals differ among the various species. G. Noise 1. A sound classified as noise results from an irregular vibration. 2. There is no definite borderline between tone and noise.	
Hearing Sound A. Introduction B. The Ear 1. The ear is a sense organ. 2. The function of the ear is to change sound energy into nerve impulses. 3. The chief parts of the ear are the outer ear, the middle ear, and the inner ear. C. Deafness 1. Hearing ability can be measured with an instrument called an audiometer. 2. Sound energy is measured in units known as decibels. 3. Sound waves can be directed around defective parts of the ear by means of hearing aids.	A) Encouragement of individual records, Present an Overview, 1. Structure and function of the human ear 2. Learning Packet (Teacher Prepared) B) 1. Observation of the ear 2. Measuring Sound

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

Reference
Navarra _et.al._
pp.145,146

Learning Center
A) Printed
World of Sound Recording
Murray
Many Human Senses
Froman
Sound
Anderson, Garrard, 1962
HiFi
Eisenberg, Random House, 1958

Reference
Navarra _et.al._
pp. 159, 160

Objectives
A) Analysis of Sounds

Testing
B) Student
(See Evaluation this guide "Interaction and Learning")

Teacher
1. Note the accuracy of observation.
2. Assess competency in recording data.

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Concepts	A) Teaching Methods B) Learning Activities
The Energy of Light The Visible Spectrum	
A. Introduction B. Finding out about Light 1. Whitelight breaks apart into six spectrum colors: red, orange green, blue, violet. 2. Light bends, or refracts, upon passing at an angle from one medium to another medium. 3. The speed of light is about 186,000 miles per second. 4. The velocity of light is a constant; it is the highest speed that anything can attain. C. Waves or particles 1. Newton's corpuscular theory suggests that light consists of particles. 2. Huygens' wave theory suggests that light moves in waves, not as particles. 3. Scientists now apply both the corpuscular theory and the wave theory to their investigation of light. D. Electromagnetic Spectrum 1. A Light wave is a transverse wave; a transverse wave vibrates at a right angle to the path in which it travels. 2. Polarized light consists only of waves vibrating in the same direction, or on the same plane. 3. Light can knock electrons off certain metals; this emission of electrons is known as the photoelectric effect.	A) Discussion, Review 1. Newton's discovery of the six-color spectrum 2. Wave theory and particle theory of light 3. Polarization and the photoelectric effect 4. Learning Packet (Teacher Prepared) B) 1. Explore the properties of light 2. Observation of bands of light
Photosynthesis A. Introduction B. Early Beliefs and Theories 1. Scientists of many years ago conducted various experiments in efforts to learn how plants get food. 2. Stephen Hales, an Englishman, discovered in the 1700's that plants remove something from the air.	

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

Learning Center
A) Printed
Waves
Bixby

Objectives
A) Illumination

Testing Program
B) Student
(See Evaluation this guide "Interaction and Learning")
Teacher
1. Note the accuracy of observations

Reference
Navarra et.al.
pp178, 179, 180

Concepts	A) Teaching Methods B) Learning Activities
Photosynthesis, con't.	
C. The Discovery of Oxygen 1. Green plants return oxygen to the atmosphere. 2. The producers of combustion are water and carbon dioxide. 3. Green plants can produce oxygen only in the presence of light.	A) Educational Excursion to a Laboratory Discussion, Suggestion 1. Methods of experimentation 2. Priestley's Experiment for oxygen
D. Modern Findings and Theories 1. Light, chlorophyll, water, and carbon dioxide are necessary for photosynthesis. 2. Green plants manufacture food by means of photosynthesis. 3. Photosynthesis occurs within the leaves of a green plant. 4. Photosynthesis unfolds in two main stages: the light reactions and the dark reactions.	B) 1. Observation of the relationship of light to the growth of plants.
E. Making the Food 1. Plants use glucose, the product of photosynthesis, to make other foods; among these other foods are starches, fats, and proteins. 2. The photosynthetic reactions occur in cellular bodies known as chloroplasts.	
The Energy of the Atom	
Radioactivity A. Introduction B. Atoms in Action 1. X rays are a form of radiation; they are a part of the electromagnetic spectrum. 2. The discovery of X rays led to a study of radioactivity. 3. Becquerel and the Curies (Marie and Pierre) shared in the discovery of radioactivity. 4. Radioactive atoms give off alpha particles, gamma rays, and beta particles.	A) Discussion, Introduction to Review, Discussion of students reports 1. Atom 2. Henri Becquerel's contribution to radioactivity 3. Table of radioactive isotopes 4. Radioactive series 5. Learning Packet (Teacher Prepared) B) 1. Survey of community to locate facilities which use radioactive materials 2. A radioactive series

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Reference Navarra et.al. pp.193.194	Objectives A) Illumination and plant growth Testing Program B) Student (See Evaluation this guide "Interaction and Learning") Teacher 1. Note the extent of open-mindedness as to the variety of other possibilities that might be proposed 2. Assess ability to predict in terms of other pertinent problems 3. Provide for the use of controls
Learning Center A) Printed Atoms, Energy, andMachines McCormick Atomic Energy Atoms (The Core of All Matter) Korn, Golden Press, 1961 Atomic Power, Simon and Schuster Reference Navarra et.al. pp. 211,212,213	Objectives A) Radioactive Isotopes Testing Program B) Student (See Evaluation this guide "Interaction and Learning") Teacher 1. Assess competency in recording data 2. Assess the application of findings to appropriate situations 3. Note willingness to check results against the findings of reliable authorities

Concept	A) Teaching Methods B) Learning Activities
Radioactivity, con't.	
C. From Isotope to Isotope 1. An isotope is a type of an element; an isotope of an element differs from another isotope of the same atom only in atomic weight, that is, in the number of neutrons it contains. 2. An atom decays and becomes a different type of atom when its nucleus emits an alpha or a beta particle; such an atom is radioactive. 3. Half-life is the time it takes for one half of any given quantity of a radioactive element to change into a new element. D. Radioactive Series 1. The decay of one atom leads to the decay of other atoms in a radioactive series. 2. Nuclear physicists write balanced equations to show nuclear reactions.	
Reactors and Accelerators	A) Introductory discussion, Suggestion 1.Otto Hahn, Fritz Strassman, and Lise Meitner 2. Use of nuclear fuels 3. Functions of parts of a nuclear reactor 4. Accelerators 5. Learning Packet (Teacher Prepared)
A. Introduction B. Splitting the Atom 1. Nuclear fission is the splitting of an atom. 2. The splitting of an atom gives rise to a chain reaction. 3. Energy is released when an atom splits. 4. Nuclear fusion is the joining of one atomic nucleus with another. 5. Energy is released in fusion. C. Atomic Power Plants 1. A nuclear reactor is an "atomic furnace"; the nuclear reactor uses the energy of the atom to generate heat energy. 2. A nuclear reactor consists of six main parts: moderator, coolant, shielding, fuel rods, control rods and heat exchanger. 3. Nuclear reactors are used to manufacture radioisotopes.	

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

Learning Center
A) Printed
Atoms, Energy, and Machines
McCormick
Atomic Energy
The Story of Atomic Energy
Fermi, Random House
Atomic Power,
Simon and Schuster

Objectives
A) Acceleration of elementary particles

Testing Program
B) Student
(See Evaluation this guide "Interaction and Learning")

Teacher
1. Note the accuracy of observations
2. Note judgement in interpreting data

Reference
Navarra, et.al.
pp. 226, 227, 228

Concepts

Reactors, con't.

D. The Atom Smashers
   1. A particle accelerator accelerates atomic particles to tremendous velocities; these high-speed particles then strike the nuclei of target atoms, causing them to split.
   2. An accelerator is a research tool; it enables physicists to observe the behavior of nuclear particles.
   3. There are various kinds of accelerators.

Electronics

Moving Electrons

A. Introduction
B. Free Electrons
   1. The electron is a particle of negative electricity.
   2. Free electrons are apart from the atom and can give rise to an electric current.
   3. Electrons have mass, velocity, and energy.
C. Tubes and Transistors
   1. The emission of an electric current by a hot filament is known as the Edison effect.
   2. Transistors and electron tubes can amplify current.
   3. A diode serves as a rectifier; a rectifier changes alternating current into direct current.
   4. A transistor ia a semiconductor; a semiconductor behaves as a conductor under some circumstances and functions as an insulator under different conditions.
   5. The transistor performs all the functions of an electron tube.
D. How Radio Works
   1. A radio **microphone** converts sound waves into electric impulses.
   2. A radio transmitter converts electric impulses to radio waves.
   3. A radio receiver converts radio waves into sound waves.

A) Teaching Methods
B) Learning Activities

A) Explanation, Discussion
   1. Importance of the radio, television, radar and computers to modern life
   2. Electrolysis as it relates to electronics
   3. Learning Packet (Teacher Prepared)

B) 1. Investigation of the electron

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Evaluation
A) Expected Outcome
B) Testing Program

Learning Center
A) Printed
  Masers and Lasers,
  Klein
  World of Sound Recording
  Murray
  Building With Electronics
  Zarchy
  Robots & Electronic Brains
  Understanding Electronics
  Lewellen , Crowell, 1957
  HiFi
  Eisenberg, Random House, 1958

Objectives
A) Static Electricity

Testing Program
B) Student
  (SeeEvaluation this guide
  "Interaction and Learning")

  Teacher
  1. Note the accuracy of
  observations

Reference
Navarra, et.al.
pp. 248, 249. 250, 251

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Concepts	A) Teaching Methods B) Learning Activities
The Electronic Computer A. Introduction B. The Computer, A Processor 1. An electronic computer is a data-processing machine. 2. Data processing consists of six basic operations: classifying, sorting, calculating, summarizing recording, and communicating. 3. The circuits in first-generation computers are made up of vacuum tubes; the circuits in second-generation computers consist of transistors. C. Kinds of Computers 1. The analog computer sets up a model of the problem being solved. 2. The digital computer works with digits; it processes data. D. Binary Arithmetic 1. Both the decimal system and the binary system are positional numeration systems. 2. The binary numeration system is a base-two system; it consists of only two digits: 0 and 1. 3. In a digital computer, a tube or transistor signifies 0 when it is off and 1 when it is on. E. Parts of a Computer 1. A digital computer consists of five main parts: input, control unit, arithmetic unit, memory unit, and output. 2. The arithmetic unit solves problems; the other parts of the computer channel the information. F. Automation	A) Educational, Discussion, Comparison 1. Simple computers 2. Analog and digital computers 3. Positional systems: decimal; binary 4. Five main parts of an electronic computer 5. Learning Packet (Teacher Prepared) B) 1. Observations of computers on visitation to a computer center 2. Parts and function of an electronic computer 3. Reports on automation
Dissectograph-Inside the Computer A. Computer Cabinet B. Parts of the Computer C. Data Flow D. The Circuit Card E. The Computer in Review	A) Introduction, Review Discussion Guide students through an investigation of the computer 1. Functions 2.Cards, magnetic tape, perforated tape 3. Learning Packet (Teacher Prepared) B) 1. Search for facts 2. To compile data 3. To interpret data

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Results B) Testing Program
Learning Center A) Printed Galileo and The Magic Numbers Robots & Electronic Brains Calculators and Computers Kenyon, Harper& Row, 1961	Objectives A) The function of electronic computers Testing Program B) Student (See Evaluation this guide "Interaction and Learning:) Teacher 1. Note the accuracy of observation 2. Assess competency in recording data 3. Note judgments in interpreting data 4. Assess the verification of findings
Reference Navarra et.al. pp.265	
Learning Center A) Printed Calculators and Computers Kenyon, Harper & Row	Objectives A) Analysis of an electronic computer Testing Program B) Student (See Evaluation this guide "Interaction and Learning") Teacher 1. Identify hypothesis 2. Provide for the use of controls

Concepts

From Atmosphere to Space

Supersonic Flight

A. Introduction

B. Aerodynamics of Flight

1. Aerodynamics is the study of air flow.
2. Four forces act upon an airplane in flight; these forces are gravity, lift, thrust, and drag.
3. For every action, there is an opposite and equal reaction.

C. Faster than Sound

1. A supersonic aircraft flies faster than sound.
2. The gas molecules of air carry pressure waves which we hear as sound waves.
3. The speed of sound varies with air temperature and altitude.
4. A measurement of Mach 1 indicates that an airplane is flying at the speed of sound; at Mach 2, the airplane is flying at twice the speed of sound.

D. Buffeting at Mach 1

1. At less than the speed of sound, an airplane sets up a normal pre pressure(sound wave); this wave clears a path for the airplane as it advances through the air.
2. Flying at the speed of sound, an airplane catches up with its own pressure wave; it smashes into the forward air, creating a tremendous shock wave.
3. When the airplane exceeds the speed of sound, the shock wave spreads out and moves along with the aircraft; the turbulence subsides.

E. Guided Missles

1. A Missile is anything thrown as a weapon; a rocket is a missile when used as a weapon.
2. A guided missile is an aerial vehicle directed to its target while in flight.
3. Some guided missiles are propelled by jet engines; such missiles have rudders, elevators and ailerons.

A) Teaching Methods
B) Learning Activities

A) Introductory Review of Elementary aerodynamics, Discussion, Suggestion
1. Bernoulli's Principle
2. Newton's third law of motion
3. The Mach system
4. Learning Packet (Teacher Prepared)

B) 1. Writing Reports

A) Printes
B) Audio Visual
Resources C) People
D) Places

Learning Center
A) Printed
America's Explorers of Space
Going into Space,
Clarke
Space Pioneers
Norton
Into Space with the Astronauts
The Wonders of Space
Rockets and Missles

Reference
Navarra, et.al.
pp. 286,297

A) Expected Outcome
Evaluation B) Testing Program

Objectives
A) Supersonic Flight

B) Testing Program
Student
(See Evaluation this guide
"Interaction and Learning")
Teacher
1. Note the accuracy
of observations

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Concepts	A) Teaching Methods B) Learning Activities
Rockets and Rocketry	
A. Introduction B. The Rocket 1. A rocket carries its own oxygen; it is not dependent upon the atmosphere for the firing of its engine. 2. A propellant consists of a fuel and an oxidizer; the oxidizer contains oxygen. 3. A liquid-propellant rocket uses a liquid fuel and a liquid oxidizer; a solid-propellant rocket burns a solid propellant consisting of both fuel and oxidizer. C. Rocket Propulsion 1. Newton's third law of motion explains the lift-off of a rocket: for every action there is an equal and opposite reaction. 2. Mass ratio is the relationship of the weight of a rocket to its own weight plus the weight of its propellant and payload. 3. The mass ratio of a rocket determines its velocity. D. Speed of the Rocket 1. The greater the exhaust velocity, the greater is the forward velocity of the rocket itself. 2. In rocketry, thrust is a capability to move weight; the thrust of a rocket is measured in pounds. 3. The clustering of engines increases the thrust of a rocket. 4. Specific impulse is a measure of a rocket's performance. 5. Specific impulse is the number of pounds of thrust obtained for each pound of propellant burned in one second. E. The Nuclear Rocket	A) Relate content to current events, Discussion Explanation 1. Various Rockets 2. Liquid-Propellant and solid-propellant rockets 3. Escape velocity 4. Velocity and mass ratio 5. Learning Packet (Teacher Prepared) B) 1. Investigation of rocketry 2. Construct models of rockets

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Learning Center
A) Printed
- America's Explorers of Space
- Going into Space
- Clarke
- Space Pioneers
- Norton
- Into Space with the Astronauts
- The Wonders of Space
- Rockets and Missles
- Space Flight, Golden Library of Knowledge
- Satellites, Rockets and Outer Space
- Ley

Reference
Navarra, et.al.
pp.300,301

Evaluation
Expected Outcome
B) Testing Program

Objectives
A) Testing of Saturn V

Testing Program
B) Stidemt
(See Evaluation this guide "Interaction and Learning")

Teacher
1. The purpose of the investigation
2. Recognize the total design of the investigation
3. Note judgments in interpreting data
4. Note the extent of open-mindedness as to the variety of other possibilities that might be proposed

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Concepts

Satellites in Orbit

A. Introduction
B. Satellites in Orbit
   1. The moon is a natural satellite of the earth.
   2. Such satellites as Telstar and Tiros are artificial earth satellites; they are man-made moons.
   3. Gravity holds an artificial earth satellite in orbit; gravity pulls the satellite around the earth.
   4. A certain velocity is required to keep a satellite in orbit at a specified altitude.
   5. As the altitude of a satellite increases, the size of its orbit increases.
C. Telemetry
   1. Telemetry is the transmission of physical data from a source of information to a point some distance from the source.
   2. The three requirements of a telemetry system are (1) a signal (2) a means of transmission, and the (3) conversion of the signal into a readable message.
   3. There are three kinds of telemetry: mechanical, electrical, and radio.
D. Communication in Space
   1. Communications is a method of sending information from place to place.
   2. Microwaves are extremely high-frequency radio waves.
E. Man in Space
   1. A docking maneuver is necessary for a flight to the moon.
   2. Astronautics is the science of space travel.

A) Teaching Methods

B) Learning Activities

A) Discussion, Suggestion
   1. Artificial earth satellites
   2. Everyday uses of telemetry
   3. Latest exploits in space
   4. Learning Packet (Teacher Prepared)

B) 1. To determine altitude velocity
   2. Observation of velocity changes the path of a projectile
   3. Observation of radio telemetry

Resources
- A) Printed
- B) Audio Visual
- C) People
- D) Places

Learning Center
A) Printed
America's Explorers of Space
Going Into Space
Clarke
Space Pioneers
Norton
Into Space with the Astronauts
The Wonders of Space
Rockets and Missles
Space Stations
Bergaust, 1963

Reference
Navarra, et.al.
pp. 312, 313

Evaluation
- A) Expected Outcome
- B) Testing Program

Objectives
A) Satellite communication

Testing Program
B) Student
(See Evaluation this guide "Interaction and Learning")

Teacher
1. Define the purpose of the investigation
2. Recognize the total design of the investigation
3. Note the accuracy of observations

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SCIENCE - 7TH AND 8TH YEAR - Navarra, Strahler,
Our Planet in Space
The Earth Sciences
Harper & Row, New York, 1967

Interpreting Our Earth Through Energy Systems
  Interpretation, A Process of Science
  Energy
  The Sun
  The Earth Sciences
Energy Systems of Planet Earth
  The Earth in Motion
  Energy Balance Between Earth and Sun
  The Energy Exchange
  The Solar Wind
  The Energy of Impacts
  The Stars, Energy Systems Like our Own
Energy Systems of Atmosphere and Oceans
  Energy Exchanges by Atmospheric Circulation
  Exchanges of Heat Energy on Land and Sea
  Energy Exchanges Through Atmospheric Moisture
  Energy Releases in the Atmosphere
  Energy Exchanges Within the Oceans
Energy Exchanges in the Land - Surface Zone
  Energy Expended at the Land-Atmosphere Interface
  The Energy of Flowing Water
  Work of Glacial Ice Upon the Lands
  Work of Waves and Tides Upon the Shore
  Work of Winds Upon the Land
Energy Systems in the Solid Earth
  Rise of Molten Rock in the Earth's Crust
  Bending and Breaking of the Earth's Crust
  Rifting of Ocean Basins and Continents
  Energy Systems Through Geologic Time

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Concepts	A) Teaching Methods B) Learning Activities
Our Planet in Space Interpretation A Process of Science A. Introduction B. Explaining Things 1. To interpret is to explain, or to set forth the meaning of observable phenomena or the meaning of observable conditions. 2. Interpretation is an important process of science. C. Ways of Reasoning 1. Inductive reasoning is a method of moving from the particular to the general and deductive reasoning moves from the general to the particular. 2. Scientists use both the inductive method and the deductive method. D. Earth and Energy 1. Energy is constantly bringing about changes on the earth and in the earth. 2. An energy system is an arrangement of substances in which energy or matter flows from one part to another.	A) Lecture, Demonstration, Suggestion, Explanation, Discussion 1. Inductive and deductive methods. 2. Learning Packet (teacher prepared) B) Observation of weather and earth rotation.
Energy A. Introduction B. Physics and Forms 1. Energy is the ability to do work. 2. A force is a push or pull on something; it is any influence that produces motion or prevents motion. 3. Work is the operation of a force through distance. 4. Motion is movement; something moves when work is being done. 5. There are various forms of energy: mechanical, electrical, light, heat, chemical, nuclear.	A) Lecture, Demonstration, Discussion, Oral Quiz 1. Interrelationships 2. Properties of matter. 3. Learning Packet (teacher prepared) B) Survey of energy of the home and community.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) The Earth's Story, Ames and Wyler Your World in Motion The Planet Earth	A) 1. Interpretation 2. Direct investigation of planet earth
Reference: Navarra, et. al. pp. 11, 12, 13	B) Student 1. What aspect am I interested in? 2. What do I want to find out? 3. How will I find out? 4. What are some possible answers? 5. What are my conclusions? Teacher 1. Accuracy of observations. 2. Skills in experimentation. 3. Competency in recording data. 4. Identification of hypotheses. 5. Clarity and accuracy in stating conclusions. 6. Note capacity for self-evaluation.
Learning Center A) Atoms, Energy and Machines, McCormick Wonders of Physics Energy and Power, Golden Library of Knowledge	A) Practical uses of energy. B) Student (See evaluation this guide "Interpretation")
Reference: Navarra, et. al. pp. 23, 24, 25	Teacher 1. Skills in experimentation. 2. Note judgments in interpreting data. 3. Accuracy of observations.

Concepts	A) Teaching Methods B) Learning Activities
C. Moving or Stored 1. Kinetic energy is energy of motion. 2. Potential energy is stored energy. D. Flow of Energy 1. Energy is constantly flowing from one point on the earth to another point. 2. The flow of energy brings about changes on the earth and in the earth. 3. Energy flows by means of conduction, convection, and radiation. 4. Heat moves naturally from a hot object to a cold object.	
The Sun A. Introduction B. An Ordinary Star 1. The sun is a hot ball of gas. 2. The sun is a medium sized star. 3. The sun is in motion; it travels through space and rotates on its axis. C. Regions of the Sun 1. The surface of the sun is known as the photosphere. 2. The sun has an "atmosphere" consisting of the chromosphere and the corona. 3. A connective zone and a radiative zone are found within the interior of the sun. 4. The sun has a core consisting of hot, dense gases; the core is the source of most of the sun's energy. 5. Sunspots can be seen on the surface of the sun; the sunspots provide evidence of the sun's rotation.	A) Lecture, Demonstration, Class Discussion, Illustration, Review 1. Density 2. Chromosphere, photosphere, and the core of the sun. 3. Learning Packet (teacher prepared) B) Observation of the sun.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) *Sun and Its Family* *The Sun: Star Number One* Wimmer, Crowell, 1964	A) Sunspot activity
	B) Student (See evaluation this guide "Interpretation") Teacher 1. Skills in experimentation. 2. Accuracy of observations. 3. Judgments in interpreting.
B) Reference: Navarra, *et. al.* pp. 38, 39	

Concepts

D. Fusion and Energy
   1. Nuclear fusion gives rise to the sun's energy.
   2. Hydrogen nuclei in the core of the sun fuse into helium nuclei.

E. The Sun's Future

The Earth Sciences

A. Introduction

B. Matter and Parts
   1. The earth consists of three main parts - the lithosphere, hydrosphere, and atmosphere.
   2. The lithosphere is solid; the hydrosphere liquid; the atmosphere gaseous.

C. Sciences of Earth Sciences
   1. The earth scientist applies several disciplines to his investigation of the earth.
   2. Among the various earth sciences are the geosciences, oceanography, and solar-system astronomy.

D. Interacting Spheres
   1. The lithosphere, hydrosphere, and atmosphere react and interact with one another.
   2. The exchange of energy between parts of the earth occurs within special zones known as interfaces.

E. Interdisciplinary Science
   1. Earth science is an interdisciplinary science.
   2. The earth sciences deal largely with objects and forms that can readily be observed.

A) Teaching Methods
B) Learning Activities

A) Lecture, Demonstration, Student Suggestions, Illustration, Review
   1. Lithosphere, hydrosphere and atmosphere.
   2. Various branches of earth science.
   3. Learning Packet (teacher prepared)

B) 1. Observation of identifying features of the earth sciences.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) The Earth's Story, Ames and Wiler	A) Scope of earth sciences.
	B) Student (See evaluation this guide "Interpretation")
Reference: Navarra, et. al. pp. 53, 54, 55	Teacher 1. Accuracy of observation. 2. Ability in formulating pertinent data. 3. Appraise the student's efforts to convey what he has learned to others; assess the skills of communication.

Concepts

The Earth in Motion

A. Introduction

B. Energy of Motion
   1. The solar system possesses kinetic energy.
   2. The earth's orbit around the sun is an ellipse.
   3. Kepler's laws of planetary motion explain the motions of the planets.
   4. The angular momentum of the earth in orbit is constant.

C. Rotation of the Earth
   1. The earth rotates in a west-to-east direction; it spins in a counterclockwise direction.
   2. The earth's axis is inclined with respect to the plans of its orbit.
   3. The sidereal day is measured in reference to a star; the solar day is measured in reference to the sun.
   4. The earth's speed of rotation can be measured according to angular velocity and also according to linear velocity.

D. The Circular Path
   1. Inertia is the tendency of an object in motion to remain in motion.
   2. Centripetal force tends to pull a moving object toward a center of rotation.
   3. Inertia keeps the earth in motion; centripetal force pulls it into a nearly circular path in its revolution around the sun.

E. Gravity and Mass
   1. Each body of matter is attracted to every other body in the universe; this force is gravitation.
   2. Gravity pulls things toward the center of the earth.
   3. Acceleration of gravity is 32 feet per second per second.

A) Teaching Methods
B) Learning Activities

A) Review Concepts, Discussion, Demonstrate, Experimentation
   1. Kepler's three laws of planetary motion.
   2. Tilting of the earth's axis.
   3. Angular velocity and linear velocity.
   4. Universal law of gravitation.
   5. Learning Packet (teacher prepared)

B) Observation of planetary motion.

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Learning Center
A) Stars
The Stars, Adler

Reference:
Navarra, et. al.
pp. 74, 75, 76

Evaluation
A) Expected Outcome
B) Testing Program

A) Tracking the stars photographically.

B) Student
(See evaluation this guide "Interpretation")

Teacher
1. Purpose of the investigation.
2. Judgments in interpreting data.
3. Competency in recording data.
4. Assess the verification of findings.

Concepts

Energy Balance
Between Earth and Sun

A. Introduction
B. Electromagnetic Radiation
    1. Solar energy radiates outward from the sun.
    2. The Sun's energy reaches the earth in the form of electromagnetic radiation.
    3. The electromagnetic spectrum is made up of various forms of radiation.
C. Energy and Atmosphere
    1. Solar radiation passes through the atmosphere before it reaches the surface of the earth.
    2. Earth scientists can measure the amount of solar radiation reaching the earth.
D. Structure of the Atmosphere
    1. The atmosphere is a mixture of gases consisting chiefly of nitrogen.
    2. The atmosphere is divided into two main zones: the homosphere and the heterosphere.
E. Through the Atmosphere
    1. Within the atmosphere there are areas with special characteristics: the ionosphere, and the ozone layer.
    2. Free electrons set up an electric current within the ionosphere.
    3. Atoms within the ionsphere undergo ionization; that is, they lose electrons and become positively charged.

A) Teaching Methods
B) Learning Activities

A) Review, Lecture, Demonstration
    1. Absorption of solar radiation.
    2. Homosphere and heterosphere.
    3. Learning Packet (teacher prepared)

B) Observation and experimentation of the electromagnetic spectrum.

A) Printed
B) Audio Visual
Resources C) People
D) Places

Reference:
Navarra, et. al.
pp. 92, 93

A) Expected Outcome
Evaluation B) Testing Program

A) Experimental absorption and radiation of heat energy.

B) Student
(See evaluation this guide "Interpretation")

Teacher

1. Observe the student's skills in experimentation.
2. Note judgments in interpreting data.
3. Note the accuracy of observations.
4. Assess competency in recording data.

Concepts

A) Teaching Methods
B) Learning Activities

F. Earth's Heat Energy
   1. Solar radiation reaching the earth is absorbed and transformed into heat energy.
   2. The earth radiates heat energy back into the lower atmosphere.
   3. Water vapor and carbon dioxide within the lower atmosphere trap the heat waves radiating from the earth. This is the greenhouse effect.

G. Outgoing Energy
   1. The earth gives off the amount of heat which it absorbs.
   2. Everything having a temperature above absolute zero radiates energy.
   3. The earth's planetary temperature (-9.4° F) enables it to give off as much radiation as it receives.

The Energy Exchange

A. Introduction

B. Energy and Latitude
   1. Solar radiation heats the surface of the earth unequally.
   2. Air circulation and the circulation of ocean water bring about a transfer of heat between the equatorial belt and the arctic regions.

C. Energy Exchange and Seasons
   1. Two conditions influence the amount of solar radiation falling upon the earth: (1) the angle between the surface and the sun's rays; (2) the length of time the surface is exposed to the sun's rays.
   2. Half of the earth's surface lies in the sun's rays; half of the surface lies in the shadow.

A) Lecture, Demonstration, Discussion
   1. Latitude, seasons and rotation.
   2. Parallels, meridians, small circles, and great circles.
   3. Learning Packet (teacher prepared)

B) 1. Experiment
   2. Graphs
   3. Interpretation
   4. Duplication of diagrams

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

Reference:
Navarra, et. al.
pp. 106, 107, 108

A) Atmospheric effects on solar radiation

B) Student
(See evaluation this guide "Interpretation")

Teacher
1. Observe the student's skills in experimentation.
2. Assess competency in recording and interpreting data.
3. Ability in formulating pertinent data.

Concepts

A) Teaching Methods
B) Learning Activities

3. The circle of illumination is the dividing line between the sunlit portion of the earth and the darkened side of the earth.
4. The circle of illumination passes through the poles of the earth twice during a year: (1) at the vernal equinox and (2) at the autumnal equinox.
5. Twice during a year the sun seems to change its direction in its north-to-south movement: (1) at the winter solstice and (2) at the summer solstice.
6. As the earth revolves, first the Northern Hemisphere and then the Southern Hemisphere is tilted toward the sun.

D. Earth's Rotation
   1. There is a daily variation in the amount of energy reaching the earth and in the amount leaving the earth.
   2. The daily cycle of solar energy changes through the seasons.
   3. Rotation sets up the cycle of incoming and outgoing energy.

The Solar Wind
A. Introduction
B. Solar Plasma
   1. Solar plasma is a cloud of gas; it is an extension of the sun's corona.
   2. Like all plasma, solar plasma consists of free electrons and positive ions.
   3. The electrons and hydrogen ions which make up solar flares come together to form an ion cloud; this cloud is plasma.

A) Suggestion, Discussion, Lecture, Investigation, Demonstration, Problem-Solving
   1. Solar wind
   2. Photosphere, sunspots and solar prominences
   3. Orsted's experiment
   4. Learning Packet (teacher prepared)

B) 1. Experiment
   2. Labeling
   3. Observation
   4. Outline
   5. Map reading
   6. Use of compass

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Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Reference: Navarra, et. al. pp. 121, 122	A) Magnetic declination B) Student (See evaluation this guide "Interpretation") Teacher 1. Skills in experimentation. 2. Competency in recording data. 3. Accuracy of observation. 4. Judgments in interpreting data. 5. Manipulation of equipment.

Concepts

A) Teaching Methods
B) Learning Activities

C. The Magnetic Earth
  1. The solar wind is a steady flow of plasma moving outward from the sun toward outer space.
  2. The solar wind is closely associated with the sun's corona; it flows within the corona.
  3. Compared with the speed of electromagnetic radiation, the solar wind moves slowly through space.

D. The Outer Field
  1. Magnetic lines of force extend from the earth in great loops to form a pattern similar to the lines of force around a dipole magnet.
  2. The solar wind exerts pressure on the earth's magnetic lines of force, creating a distortion in the doughnut-shaped pattern which the lines of force normally would form.
  3. Solar plasma forms a sharp outer boundary which surrounds the earth's magnetic field; this boundary, the magnetopause, enclosed the magnetosphere.
  4. The magnetosphere is a region of trapped particles.
  5. The Van Allen radiation belts lie within the magnetosphere.

E. Aurora Borealis
  1. Scientists believe the electrons and protons of the outer Van Allen radiation belt give rise to the auroras.
  2. Electrons and protons of the Van Allen radiation belt strike gas molecules in the ionosphere; with this collision, the molecules emit the light which produces the auroras.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

Concepts

The Energy of Impacts

A. Introduction

B. Asteroids
   1. An asteroid is a small planet revolving around the sun between Mars and Jupiter.
   2. Astronomers have photographed at least 40,000 asteroids.
   3. Asteroids possibly are the fragments of a full-sized planet which disintegrated.

C. Meteoroids
   1. A meteoroid is a particle of matter moving through space.
   2. A meteor is a meteoroid that enters the atmosphere.
   3. A meteor which strikes the ground is known as a meteorite.
   4. Meteoroids sometimes enter the atmosphere in great numbers and give rise to a meteor shower.
   5. Large meteorites form meteorite craters when they hit the ground with tremendous force.

D. Comets
   1. An object which travels in an orbit around a planet is a moon, or a satellite.
   2. All the planets except Mercury, Venus, and Pluto have satellites.
   3. All but six of the planets' moons revolve in a counter-clockwise direction; six revolve in retrograde, or backward, orbits.
   4. A comet is a luminous object which revolves around the sun in a wide orbit; it consists of a "head," and a long streaming "tail."
   5. A comet is made up of dust particles and gaseous matter; it has low density.

A) Teaching Methods
B) Learning Activities

A) Discussion, Demonstration
   1. The solar system
   2. Asteroids
   3. Meteoroids
   4. Comets
   5. Learning Packets (teacher prepared)

B) 1. Experiment with eclipses.
   2. Observation of the moon.

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Learning Center
A) Moon
The Moon, Binder,
Golden Library of Knowledge

Reference:
Navarra, et. al.
pp. 136, 137, 138, 139

Evaluation
A) Expected Outcome
B) Testing Program

A) Movements of the moon.

B) Student
(See evaluation this guide "Interpretation")

Teacher
1. Accuracy of observations.
2. Skills in experimentation.
3. Appraise the student's efforts to convey what he has learned to others; assess the skills of communication.

Concepts	A) Teaching Methods B) Learning Activities
E. The Earth's Moon 1. The moon is a huge ball of rock. 2. The moon rotates on its axis and revolves around the earth in an elliptical orbit. 3. The moon shows up in phases as it revolves around the earth. 4. A lunar eclipse occurs when the earth's shadow falls upon the moon. 5. Only one side of the moon is visible from the earth because the moon's rotation is in step with its revolution. F. The Moon's Surface 1. The energy of impacts has helped to shape the surface of the moon. 2. The moon has an irregular surface consisting of plains, mountains, and craters.	
The Stars, Energy Systems Like Our Own A. Introduction B. Finding Out 1. An astronomer learns about a star by analyzing its radiated energy. 2. The light of a star enables an astronomer to determine its location. 3. An astronomer observes the direction of a star's beam; he measures the star's brightness; he analyzes its spectrum. C. Directions and Distances 1. All stars have a position in the celestial sphere. 2. An astronomer can measure the distance of a star by means of triangulation. 3. The parallax effect enables an astronomer to measure distance of a star.	A) Review, Suggestion, Demonstration 1. The astronomer. 2. Charting the sky. 3. Various types of telescopes. 4. Learning Packet (teacher prepared) B) Observation of constellations.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) *Planets, Stars, and Space*, Chamberlain and Nicholson *Stars*	A) Locating constellations. Conceptualization of an energy system.
B) Planetarium and Star Charts Reference: Navarra, *et. al.* pp. 151, 152, 153	B) Students (See evaluation this guide "Interpretation") Teachers 1. Accuracy of observation. 2. Skills in experimentation. 3. Ability in formulating pertinent data.

Concepts

A) Teaching Methods
B) Learning Activities

D. Brightness of Stars
   1. The apparent brightness of a star is called its magnitude.
   2. Scientists have worked out a scale of magnitude; this scale represents a system for classifying stars according to their magnitude.
   3. Luminosity, or actual brightness, is the light output of a star.

E. Mass and Luminosity
   1. The quantity of matter in a star is its mass.
   2. The greater the mass, the greater is the luminosity of a star.

F. The Radiation Spectrum
   1. The spectroscope is the astronomer's tool for analyzing starlight.
   2. An absorption spectrum reveals the make-up of a star.
   3. The Doppler effect reveals the direction of a star's motion.
   4. Having different temperatures, stars have different colors.

G. A Star's Life Cycle
   1. A diffused cloud of cold gases and cold dust gives birth to a star.
   2. As the temperature of a star rises, hydrogen atoms begin to fuse into helium.
   3. A star eventually loses its energy; it becomes a cold, burned-out object in space.
   4. The life cycle of a star spans billions of years.

H. Our Galaxy and Others
   1. The solar system (including the earth) lies within an assembly of stars known as Our Galaxy.
   2. There are many galaxies in space.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

S m 80

Concepts

Energy Exchanges By Atmospheric Circulation

A. Introduction

B. Wind
   1. The atmosphere presses down upon the surface of the earth; it has pressure.
   2. Wind is moving air; differences in air pressure cause winds to blow.
   3. Air moves as wind from regions of high pressure toward regions of low pressure.

C. Convection
   1. Convection is the vertical movement of currents.
   2. Convective circulation occurs within the atmosphere when cold air moves in to replace rising warm air.
   3. A pocket of warm air creates a center of low pressure, or a low; a region of cold air creates a center of high pressure, or a high.
   4. The pressure-gradient force is the driving force of all winds.
   5. Local winds such as sea breezes and land breezes are examples of convective circulation.

D. Planetary Circulation
   1. The planetary circulation of the atmosphere is broken up into a pattern of wind belts.
   2. The Coriolis effect influences the pattern of general circulation.
   3. A band of fast westerly winds sweeps through the atmosphere at altitudes above 20,000 feet; this band is known as the jet stream.

A) Teaching Methods
B) Learning Activities

A) Introductory Lecture, Demonstration, Review
   1. The barometer
   2. Westher bureau maps.
   3. Learning Packet (teacher prepared)

B) Interpret maps.

S m 81

A) Printed
B) Audio Visual
Resources C) People
D) Places

Learning Center
A) The Way of the Weather, Spar
Weather

Reference:
Navarra, et. al.
pp. 171, 172, 173

A) Expected Outcome
Evaluation B) Testing Program

A) 1. Inductive reasoning
2. Charting the wind.

B) Student
(See evaluation this guide "Interpretation")

Teacher
1. Skills in experimentation.
2. Judgments in interpreting data.

Concepts	A) Teaching Methods B) Learning Activities
Exchanges of Heat Energy on Land and Sea	
A. Introduction 1. There are various kinds of thermometers. 2. The meteorologist uses a liquid-in-glass thermometer to measure air temperature. 3. The commonly used temperature scales are the Fahrenheit scale and the centigrade scale.	A) Lecture, Display, Demonstration 1. Thermometers 2. Variation of temperatures. 3. Learning Packet (teacher prepared) B) 1. Summarize data 2. Comparisons
B. Land and Water 1. Land surfaces tend to heat more rapidly and reach higher temperatures than do water surfaces. 2. Land surfaces tend to cool more rapidly and reach lower temperatures than do water surfaces. 3. Temperatures vary only slightly from day to night in coastal regions; there is a marked difference between daytime temperatures and nighttime temperatures in inland regions. 4. Water has a high specific heat. 5. Evaporation is a cooling process.	
C. Cycles and Temperature 1. There are seasonal variations in the amount of solar energy which the earth receives. In winter, solar energy is low; in summer, it is high. 2. The earth radiates most of the heat it receives from the sun back into the atmosphere. 3. A process known as conduction carries some of the earth's incoming heat slowly downward into the lower layers of soil. 4. There are seasonal temperature cycles in lakes and oceans; daily differences are very small.	

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Reference:
Navarra, et. al.
pp. 184, 185, 186

Evaluation
A) Expected Outcome
B) Testing Program

A) Temperature; variation in a fresh-water body.

B) Student
(See evaluation this guide "Interpretation")

Teacher
1. Clarity and accuracy in stating conclusions.
2. Assess the verification of findings.
3. Application of findings to appropriate situations.
4. Ability to predict in terms of other pertinent problems.

Concepts

Energy Exchanges Through Atmospheric Moisture

A. Introduction

B. Changes of State
   1. As matter, water can change in state: it can be a solid, a gas, or a liquid.
   2. Evaporation is a cooling process; the liberation of heat accompanies condensation.
   3. Freezing is the change of a liquid to the solid state. This change causes heat to be given off.
   4. Melting is the change of a solid into a liquid.
   5. Sublimation is the change of a solid directly into a gas; it is also the change of a gas directly into a solid.

C. Measuring Water Vapor
   1. Vapor pressure contributes to the pressure of the air.
   2. The amount of water vapor held by the air is its humidity.
   3. Water condenses out of the air when the dew point is reached.

A) Teaching Methods
B) Learning Activities

A) Discussion, Suggestion
   1. Evaporation, condensation, freezing, melting and sublimation.
   2. Graphs of relative humidity.
   3. Cloud nomenclature.
   4. Learning Packet (teacher prepared)

B) Graphing

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) The Way of the Weather, Spar	A) Charting the clouds
	B) Student (See evaluation this guide "Interpretation)
Reference: Navarra, et. al. pp. 199, 200	Teacher 1. Ability in formulating pertinent data. 2. Verification of findings.

Concepts

Energy Releases in the Atmosphere
A. Introduction
B. Air Masses
  1. An air mass is a large body of air spreading across a vast area of the earth's surface.
  2. An air mass takes on the basic characteristics of its source region; for example, air which accumulates over the arctic becomes extremely cold.
  3. Air masses are classified according to the regions in which they are formed.
  4. There are four basic types of air masses: arctic, polar, tropical, equatorial.
C. Adiabatic Temperature Changes
  1. Adiabatic cooling is the cooling of a gas brought about by a change in pressure; the release of pressure cools a gas.
  2. A sinking or rising of large air masses is the principal cause of a change in temperature.
  3. Air cools when it rises; it warms when it sinks.
  4. The relative humidity automatically increases as the air temperature decreases.
  5. Water vapor in the air begins to condense when the air reaches its dew-point temperature.
D. Weather Fronts
  1. A cold front develops when a cold air mass invades a region occupied by a warm air mass.
  2. A warm front develops when a warm air mass moves into a region occupied by a cold air mass.
  3. An occluded front forms when a warm front is cut off from contact with the ground.

A) Teaching Methods
B) Learning Activities

A) Involvement, Discussion, Review
  1. Meteorologist
  2. Records of movement of air masses
  3. Adiabatic cooling
  4. Weather fronts
  5. Learning Packet (teacher prepared)

B) Interpret Graphs

A) Printed
B) Audio Visual
Resources C) People
D) Places

Learning Center
A) The Way of the Weather, Spar
Weather
The World of Weather, SRA
Exploring the Weather,
Gallant, Garden City, 1957
Junior Science Book of Rain, Sleet and Snow,
Larrick, Garrard Press, 1961

Reference:
Navarra, et. al.
pp. 210, 211

A) Expected Outcome
Evaluation B) Testing Program

A) The behavior of a cyclonic storm.

B) Student
(See evaluation this guide "Interpretation")

Teacher
1. Ability in formulating pertinent data.
2. Application of findings to appropriate situations.
3. Willingness to check results against the findings of reliable authorities.

Concepts

E. Cyclones and Storms
   1. A low is a center of low barometric pressure; a high is a center of high barometric pressure.
   2. A low is known to the weatherman as a cyclone.
   3. A tornado is a very small but particularly destructive and violent cyclone.
   4. The tropical cyclone is large, violent, and destructive; such a cyclone is known as a hurrican in the West Indies and as a typhoon in the western Pacific.

Energy Exchanges Within the Oceans
A. Introduction
B. Make Up of Sea Water
   1. The water of the ocean is a solution of dissolved salts; it is brine.
   2. Flowing rivers carry salts from the land into the ocean.
   3. Water that evaporates from the ocean leaves the salts behind.
C. Physical Properties
   1. Salinity is the weight of dissolved solids in sea water compared with the weight of the water itself; salinity is a ratio.
   2. Surface water tends to be warmer than the water at the bottom of the oceans in the low latitudes and middle latitudes.
   3. The density of sea water is greater than the density of fresh water.
   4. Water pressure increases in direct proportion to the depth.

A) Teaching Methods
B) Learning Activities

A) Explanation, Discussion, Student Resources
   1. Properties of the sea.
   2. Visualization of a wave.
   3. Learning Packet (teacher prepared)

B) Ocean maping by use of pilot charts.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) The Ocean Laboratory, Spilhaus Waves, Bixby	A) Waves and wind action
Reference: Navarra, et. al. pp. 223, 224	B) Student (See evaluation this guide "Interpretation") Teacher 1. Competency in recording data. 2. Access the verification of findings.

Concepts	A) Teaching Methods B) Learning Activities
D. Waves and Wind 1. Winds produce ocean waves classified as progressive waves; one wave follows another. 2. The principal parts of a wave are the crest and the trough. The still-water level exists when there are no waves. 3. The pressure of wind has a direct bearing on the build-up of a wave. E. Ocean Currents 1. An ocean current is any flow of water within the ocean. 2. There are two principal causes of ocean currents: wind and unequal water densities. 3. Ocean currents flow as gyres in both the Atlantic Ocean and the Pacific Ocean.	
Energy Expended at the Land-Atmosphere Interface A. Introduction B. Weathering 1. Weathering is a geologic process in which sediment becomes available for transportation by wind and streams. 2. Both mechanical operations and chemical reactions cause weathering. 3. The weathering and breaking up of rocks is accompanied by mass wasting. C. Soil Forming Process 1. Soil forms a thin layer over the land surface of the earth. 2. Various processes (biological, chemical, physical) go into the making of soil. 3. Many soils show horizontal layers which show up in an arrangement known as a soil profile.	A) Discussion, Suggestion, Review 1. Geomorphology 2. Geometry of rock disintegration 3. Learning Packet (teacher prepared) B) Investigating weathering

A) Printed
B) Audio Visual
Resources C) People
D) Places

Reference:
Navarra, et. al.
pp. 242, 243

A) Expected Outcome
Evaluation B) Testing Program

A) Rock weathering

B) Student
(See evaluation this guide
"Interpretation")

Teacher
Access the application of
findings to appropriate
situations.

Concepts

The Energy of Flowing Water

A. Introduction

B. The Hydrological Cycle
   1. Water constantly is leaving the oceans and returning to the oceans in a process known as the hydrologic cycle.
   2. Hydrologists measure both the rainfall intensity and the runoff of water.
   3. Soil erosion is the removal of soil; the flow of water causes soil erosion.
   4. The concentrated flow of water carves out a stream channel.
   5. At its source a stream possesses potential energy; the potential energy is transformed into kinetic energy as the stream flows.

C. The Work of Streams
   1. Stream erosion is the progressive removal of material from the surfaces of a stream channel.
   2. Streams transport materials by means of traction, suspension, and solution.
   3. The amount of sediment which moves past a fixed cross section of a stream is known as the solid load; the load is given in a unit of time, such as tons per day.
   4. Streams perform three closely related forms of geological work: erosion, transportation, deposition.

D. Stream Development
   1. A stream begins to form when surface runoff falls into a drainage system.
   2. The development of a stream gives rise to deltas, alluvial valleys, and rock gorges.
   3. A stream is graded when the entering sediment matches the stream's capacity to carry the sediment.

A) Teaching Methods
B) Learning Activities

A) Explanation, Demonstration, Discussion
   1. Hydrologist
   2. Water cycle
   3. Loads and stream transport
   4. Learning Packet (teacher prepared)

B) 1. Reading
   2. Topographical maps

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) Rivers What They Do, Crosby & Larrick	A) The content of stream water
Reference: Navarra, et. al. pp. 258, 259	B) Student (See evaluation thig guide "Interpretation") Teacher Appraise the student's effort to convey what he has learned to others; assess the skills of communication.

Concepts	A) Teaching Methods B) Learning Activities
E. Water Underground 1. Water collects beneath the surface of the earth; this water is known as ground water. 2. The upper surface of the ground-water zone is the water table. 8 3. Ground water moves beneath the surface of the earth, but there is much resistance to this movement.	
Work of Glacial Ice upon the Lands A. How Glaciers Form 1. Glaciers can form only when falling snow accumulates faster than it melts or evaporates. 2. A mass of snow becomes greatly compacted when covered by new snow layers. 3. Heavily compacted snow eventually becomes glacial ice. B. Classification and Movement 1. There are two kinds of glaciers: a valley glacier and a continental glacier. 2. A valley glacier is divided into two parts: the zone of accumulation and the zone of ablation. 3. Glaciers move slowly; the center portion of a glacier moves faster than the edges. C. Erosion by Glaciers 1. A glacier is an energy system which does geologic work. 2. A glacier causes the erosion of soil and rocks as it travels; it carves out landforms.	A. Students work independently Demonstration Discussion 1. Pressure and compaction 2. Valley and continental glaciers 3. Lateral and terminal morains 4. Learning Packet (teacher prepared) B. Observations and experimentation

A) Printed
B) Audio Visual
Resources C) People
D) Places

Reference:
Navarra, et. al.
pp. 258,259

Learning Center
A) Printed
Icebergs and Glaciers
Lauber. Garrard, 1961

Reference:
Navarra, et. al.
pp. 271,272

A) Expected Outcome
Evaluation B) Testing Program

A) Progressive changes in snow
B) Student
(See evaluation this guide
"Interpretation")

Teacher
1. Willingness to check results against the findings of reliable sources.
2. Accuracy of observations

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Concepts

Work of Waves and Tides upon the Shore

A. The Surf Zone
  1. Breakers and surf carve out landforms on the shores of the ocean.
  2. Waves roll over abrasion platforms and pound against marine cliffs; with this action, the waves shape and reshape a shoreline.
  3. A beach is an accumulation of sand, gravel, or cobbles in the zone of breakers and surf; it is a depositional landform.

B. Coast Line Development
  1. A coast line develops into an embayed coast when ocean water submerges a coast having many divides and stream valleys.
  2. Various geological processes cause the development of simple gently sloping coast lines.

C. Wave Refraction
  1. Wave refraction is a change in the direction in which a wave is traveling.
  2. Wave refraction tends to straighten the shoreline.

D. Tidal Energy
  1. Ocean tides cause currents to flow in the shallow shore zone; these currents perform geologic work.
  2. The earth--moon pair revolves around a common center of gravity.
  3. The tides are caused by the tide-raising force. The gravitational force of the moon is stronger than the centrifugal force of the earth-moon pair. This difference in forces is the tidal-raising force.

A) Teaching Methods
B) Learning Activities

A) Description, Demonstration
Review Discussion, Explanation
  1. Ocean waves
  2. Marine cliffs, shingle beach and picket beaches
  3. Tidal currents
  4. Learning packet (teacher prepared)

B) Reading
Observation
Analyze
Experiment

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Learning Center
A) The Ocean Laboratory, Spilhaus
Waves, Bixby
Oceanography
Let's Explore the Shore
The Rise and Fall of the Seas; The Story of the Tides, Brindze. Harcourt, 1964
The Sea Around Us, Carson. Oxford, 1961

Reference:
Navarra, et. al.
pp. 287,288

Evaluation
A) Expected Outcome
B) Testing Program

A) Student should be able to describe beach erosion
B) Student
(See evaluation this guide "Interpretation")

Teacher
1. Accuracy of observations
2. Observe the students skills in experimentation
3. Assess the application of findings to appropriate situations
4. Assess the verification of findings

Concepts	A) Teaching Methods B) Learning Activities
E. Tidal Currents 1. As the tide rises, a flow of water toward the land produces a flood current; a falling tide gives rise to an ebb current, which is a flow of water away from the land. 2. The tidal currents function as an energy system working in conjunction with the energy system of breaking waves. F. Tidal Deposits 1. Sand deposited by waves builds up into a barrier beach along some coast lines. 2. Salt marshes form within the bays and lagoons protected by barrier beaches and baymouth bars.	
Work of Winds upon the Lands A. Wind Erosion and Dust Storms 1. Wind causes erosion; it carries away particles of clay, silt, and sand. 2. The lifting of small particles is a type of wind erosion known as deflation. 3. Sand-blast action is a type of erosion in which the wind picks up hard mineral grains and drives them against rock surfaces; this action carves out notches and hollows at the bases of cliffs.	A) Explanation, Overview, Suggestion 1. Wind erosion and its hazards 2. Loess deposits 3. Learning packets (teacher prepared) B) Maps of loess deposits Reading Outline Observation

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) Storms, Adler. John Day, 1963 The Way of the Weather, Spar. Creative Ed. Soc., 1967	A) Loess and its properties B) Student (See evaluation this guide "Interpretation") Teacher 1. Assess competency in recording data 2. Appraise students efforts to convey what he has learned 3. Assess ability in formulating pertinent data 4. Accuracy of observations

Concepts	A) Teaching Methods B) Learning Activities

B. Loess
   1. Thick deposits of dust have accumulated as loess in the North Central States and elsewhere in the United States and in Europe and Asia, generally in or near glaciated regions.
   2. The windblown dust which formed during the Pleistocene Epoch (the Ice Age) apparently later developed into loess.
   3. Loess is a layer of subsoil consisting of a porous, yellowish sediment.

C. Transport of Sand
   1. Wind serves as a sediment-sorting agent; it separates sand from gravel and dust.
   2. A sand drift remains in one spot; a sand dune often moves in the direction of the wind.
   3. A sand grain hits the ground and rebounds into the air in an action known as saltation.
   4. Grain impact produces a slow forward surface creep of the sand.

D. Drifts and Dunes
   1. The saltation and the surface creep of loose sand gives rise to two distinctive landforms, the sand drift and the sand dune.
   2. The buildup of a sand drift sometimes is the starting point of a sand dune.
   3. A sand dune can take many forms, the simplest is called the Barchan dune.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

Reference:
Navarra, *et. al*.
pp. 300

Concepts

Energy Systems in the Solid Earth

Rise of Molten Rock in the Earth's Crust

A. The Solid Earth
    1. The three main parts of the earth are the crust, the mantle, and the core.
    2. The crust of the earth is thin; the mantle lies beneath the crust.
    3. A study of earthquake waves has given geologists information about the earth's interior.
    4. The boundary between the crust and the mantle is known as the Mohorovicic discontinuity, or Moho.
    5. The core consists of an outer core and an inner core.

B. Earth's Internal Heat
    1. The radioactive decay of elements deep within the interior of the earth generates heat energy known as radiogenic heat.
    2. Radiogenic heat causes the earth's interior to be extremely hot.
    3. The earth's internal heat rises to the surface by means of conduction; rock serves as the conductor.

C. Igneous Rock
    1. Igneous rocks are formed when magma solidifies.
    2. Igneous rocks which solidify beneath the earth's surface are known as intrusive igneous rocks; those which form above the surface are classed as extrusive igneous rocks.
    3. Among the intrusive igneous rocks are granatic rocks, basaltic rocks.

A) Teaching Methods
B) Learning Activities

A) Challenge, Historical Review, Discussion, Interpretation
    1. Common igneous rocks
    2. Volcanism

B) Interpretation
Investigation

A) Printed
B) Audio Visual
ResourcesC) People
D) Places

Learning Center
A) *A Field Guide to Rocks and Minerals*
The Earth's Story, Ames and Wiler
Gem Testing
Rocks and Minerals
Rocks and Minerals: A Guide to Familiar Minerals, Gems, Ores, and Rocks, Zim. Golden Press, 1957
All About Volcanoes and Earthquakes, Pough. Random, 1953
Volcanoes and Earthquakes, Irving. Knopf, 1962

Reference:
Navarra, *et. al.*
pp. 317,318,319

A)Expected Outcome
Evaluation B)Testing Program

A) Igneous Rocks
B) Students
(See evaluation this guide "Interpretation")

Teacher
1. Purpose of the investigation
2. Total design of the investigation
3. Accuracy of observations
4. Verification of findings
5. Assess the application of findings to appropriate situations

Concepts	A) Teaching Methods B) Learning Activities
D. Volcanoes 1. Volcanism is the movement of magma outward through tubes and cracks onto the earth's surface. 2. One example of volcanism is a volcanic eruption; volcanism gives rise to a volcano. 3. Volcanism is a mountain-building process.	
Bending and Breaking of the Earth's Crust A. Earthquakes 1. An earthquake is a trembling of the ground; destructive earthquakes may leave wide, gaping cracks in the ground. 2. A movement of the earth's crust known as faulting causes earthquakes. 3. Earthquake waves, or seismic waves, move out in all directions. 4. Scientists use an instrument called the seismograph to detect seismic waves. 5. Scientists learn about the interior of the earth by studying seismic waves.	A) Discussion, Illustration, Demonstration 1. Elastic-rebound theory 2. Folding and Faulting 3. Learning packet (teacher prepares) B) Recall Observation of Earthquakes Experiment Compilation of Records

A) Printed
B) Audio Visual
Resources C) People
D) Places

Learning Center
A) The Earth's Story, Ames and Wyler
Birth of an Island, Selsam. 1966
All About Volcanoes and Earthquakes, Pough. Random, 1953
Volcanoes and Earthquakes, Irving. Knopf, 1962
Mountains, Goetz. Morrow, 1962

Reference:
Navarra, et. al.
pp. 332, 333

A) Expected Outcome
Evaluation B) Testing Program

A) Earthquakes
Volcanoes
B) Student
(See evaluation in this guide "Interpretation")

Teacher
1. Appraise the student's efforts to convey what he has learned to others
2. Accuracy of observation
3. Skills in experimentation
4. Competency in recording data

Concepts

A) Teaching Methods
B) Learning Activities

B. Mountains
   1. Diastrophism has brought about the buildup of mountains on the surface of the earth.
   2. A broadly curved formation of mountains is called a mountain arc. Arcs connected end to end form chains that nearly span the earth--the two major ones being the circum-Pacific belt and the Eurasian-Melanesian belt.
   3. Lowlands and trenches on the ocean floor parallel the mountain arcs of the continents in some places, indicating that a single set of forces raised the earth's crust along one line and depresses it along a parallel line.
   4. The buildup of sediment within a trough known as a geosyncline is the first stage in the development of some mountains.
   5. The crust of the earth floats on the mantle; this floating is known as isostasy.

C. Mountain-Building Forces
   1. Faulting and folding are not forces in themselves; they are the result of underlying forces.
   2. Heat apparently gives rise to convection currents within the earth's interior.
   3. The convection currents compress the crust; with this compression, mountains come into existence.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

Concepts

Rifting of Ocean Basins and Continents

A. Mapping the Ocean Floor
   1. Oceanographers have learned about the ocean floor by means of indirect observation.
   2. The ocean floor has an irregular surface very different from that of the continents.
   3. The three major divisions of the ocean basins are the continental margins, the ocean-basin floors, and the mid-ocean ridges.
   4. Oceanographers obtain samples of ocean-bottom sediments by dredging and core sampling.

B. Mid-Ocean Ridge System
   1. A chain of mountains known as the mid-ocean ridge system lies beneath the waters of the Atlantic Ocean, the Pacific Ocean and the Indian Ocean.
   2. Oceanographers believe that the rise of mantle rock beneath the oceans has produced the mid-ocean ridge system.

C. The Earth's Continents
   1. The oceans and continents apparently have never changed places on the face of the earth.
   2. The mid-ocean ridge system extends into the continents.
   3. Faults in Nevada, Utah, and southern Oregon have produced fault-block mountains.

A) Teaching Methods
B) Learning Activities

A) Explanation, Suggestion
   Experimentation
   1. Oceanography
   2. Learning packet (teacher prepared)

B) Research of Inner Space-the Oceans
   Mapping Underwater

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) *The Ocean Laboratory*, Spilhaus *Oceanography* *Underwater and Sea Adventure*	A) Mapping the Ocean Floor B) Student (See evaluation this guide "Interpretation").
Reference: Navarra, *et. al*. pp. 346, 347	Teacher 1. Recording data 2. Interpreting data 3. Formulating pertinent data 4. Verification of findings 5. Accuracy in stating conclusions 6. Application of findings to appropriate situations

Concepts	A) Teaching Methods B) Learning Activities
Energy Systems Throughout Geologic Time A. The Colorado Plateau 1. The rocks of the Colorado Plateau span all the eras of geologic time. 2. Sedimentary rock layers in the Grand Canyon are arranged from the bottom to the top in the order of decreasing age; this arrangement follows the law of superposition. 3. Fossils often reveal the age of a formation in which they are found. B. The Geologic Eras 1. Plant and animal life has existed prominently in three major divisions of geologic time; the Paleozoic era, the Mesozoic era, and the Cenozoic era. 2. Primitive life first appeared on earth during Precambrian time.	A) Explanation, Illustration, Discussion 1. Grand Canyon, Bryce Canyon, and Zion Canyon 2. Law of superposition and principle of continuity 3. Learning packet (teacher prepared) B) Reading of Historical Geology Observation of the Geological Eras
Science Fair	To provide opportunities for the pursuit of established interest and the development of new interest. To encourage individuals to participate in science and mathematics activities.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) The Earth's Story, Ames and Wiler The Fossil Book Prehistoric Animals, Epstein. Anthropologists and What They Do, Mead Rocks and What They Tell Us, Del Ray. Whitman Publishing, 1961 Story of Caves, Sterling. Doubleday, 1956 Good Digging, Samachson. Garrett, 1964 Life Through the Ages, Knight. Knopf, 1946 Prehistoric America, White. Random, 1951 All About Dinosaurs, Andrews. Random, 1953 Prehistoric Reptiles and Birds, Augusta. 1961	A) Interpretation of Fossils B) Student (See evaluation this guide "Interpretation") Teacher 1. Judgments in interpretation of data 2. Accuracy of observations 3. Efforts to convey what he has learned to others 4. Extent of open-mindedness as to the variety of other possibilities that might be proposed
Reference: Navarra, et. al. pp. 357, 358, 359	
People: Various local and area industries provide scientists who act as judges.	Students should show the ability to work on projects independently. Students should express an interest in science activities outside the school environment.

OVERVIEW

Navarra, Zafforoni, Garone
"Life And The Molecule"
The Biological Sciences
Harper & Row, Evanston, Ill., 1966

- Perception and Science
  - Perceiving Things
- Life in a Physical World
  - Substance and Matter
  - Living Matter
  - The Living Cell
  - Cell Organization
- Living Things
  - Classifying Living Things
  - Protists
  - Plants
  - Animals
  - The Human Body, A Dissectograph
- From Life to Life
  - Genetics, The Study of Heredity
  - Embryology, The Beginning of Life
- Chemistry of Living Things
  - Solutes and Solvents
  - Solutions in the Body
  - The Digestion of Foods
- The Living Biosphere
  - Basic Elements of Ecology
  - The Biotic Community
- Biology in Space
  - Space and Ecology
  - Life and Survival

S m 113

Concepts

Life And The Molecule
Perception And Science
Perceiving Things

A. Introduction
   1. Perception is the act of perceiving, or of becoming aware of something through the senses.
   2. Some form of energy must be available if we are to perceive; energy makes it possible for us to see, hear, feel, smell, and taste.

B. The Stimulus of Energy
   1. A stimulus is energy that activates a part of the body.
   2. To perceive, a person first must make a contact with an object, a situation, or event; a stimulus provides this contact.
   3. A stimulus can come from outside the body or from within the body.

C. Detecting Energy
   1. Sense cells and sense organs detect the energy which enables us to perceive.
   2. The five basic senses are the senses of sight, hearing, smell, taste, and touch; in all, the human body responds to more than twenty sensations.
   3. The eye is an important sense organ; it gives us the sense of sight.
   4. A combination of stimuli sharpens our perceptions; eyes and ears, for example, often work together.

A) Teaching Methods
B) Learning Activities

A) Discussion, Quiz, Stress, Experimentation, Review
   1. Perception of a broken-letter title.
   2. Stress the importance of a stimulus to the act of perceiving.
   3. Call attention to the flag observation.
   4. Examine scientific journals for communications in science.
   5. Call attention to the thumbnail biography of August Ferdinand Mobius.
   6. Review the content of this chapter.
   7. Learning Packet (teacher prepared)

B) Record keeping of pertinent data.

A) Printed
B) Audio Visual
Resources C) People
D) Places

Learning Center
A) You and Your Brain, Groch

B) Filmstrips:
Biolab Tachniques

Reference:
Life And The Molecule,
Navarra, et. al.
Harper Row, 1966
pp. 19, 20, 21

A) Expected Outcome
Evaluation B) Testing Program

A)
1. Perception of each individual and how science is a way of perceiving.
2. Properties of the Mobius Strip
3. Appreciation of the radio telescope

B) Student
1. What aspect am I interested in?
2. What do I want to find out?
3. How will I find out?
4. What are some possible answers?
5. What are my conclusions?

Teacher
1. Assess the ability to record data
2. Note capacity for self-evaluation
3. Observe approach to experiments

Concepts

A) Teaching Methods
B) Learning Activities

D. Transmitting Energy
   1. The nervous system serves as a communications network for the human body.
   2. The brain and the spinal cord make up the central nervous system; neurons, or nerve cells, form a subdivision known as the peripheral nervous system.
   3. The autonomic nervous system controls involuntary action of various body organs (the heart, stomach, and colon, for example).
   4. The brain consists of three main parts: the cerebrum, the cerebellum, and the medulla.
   5. Many impulses pass through the spinal cord on their way to the brain.

E. Perception in Science
   1. Science is a way of perceiving.
   2. Scientists solve problems and make discoveries by making contact, detecting energy, transmitting energy, and receiving energy.

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Evaluation
A) Expected Outcome
B) Testing Program

Concepts

Life In A Physical World
Substance And Matter

A. Introduction
B. Life and Energy
  1. Matter, energy, and life are closely linked.
  2. Life is difficult to define; it involves a series of processes, or applications of energy.
  3. Life is a condition of organisms.
  4. Energy is a capacity, or an ability; it is the ability to do work.
C. Properties of Matter
  1. Matter is anything that has mass and takes up space.
  2. There are three states of matter: solid, liquid, gas.
  3. Mass and weight are not the same; weight is a measure of the pull of gravity; mass is the amount of matter an object contains.
  4. Inertia is the tendency of a body at rest to remain at rest and of a body in motion to remain in motion.
  5. The greater the mass of a body, the greater is the inertia of the body.
D. Classifying Matter
  1. A substance is a particular kind of matter having specific properties.
  2. An element is a pure substance that cannot be broken down into other substances by ordinary chemical means.
  3. An isotope of an element differs from another isotope of the same element in the number of neutrons it contains and in atomic weight.
  4. A compound is a combination of two or more elements.

A) Teaching Methods
B) Learning Activities

A) Discussion, Explanation, Demonstration
  1. Discuss the meaning of the term matter - basic states - gas, liquid, solid.
  2. Explain the principle of the jumping bean.
  3. Demonstrate inertia.
  4. Stress the periodic table of elements.
  5. Learning Packet (teacher prepared)

B) 1. Observation of a bird in a tree, record notes and determine what makes the bird alive, tree alive, and do the bird and the tree share traits in common.
  2. Periodic table of elements as a reference.

A) Printed
B) Audio Visual
Resources C) People
D) Places

Learning Center
A) Observations and Experiments in Natural History
Chemistry - Matter, Molecules, Atoms, Parker
Atoms, Energy, and Machines, McCormick
Matter, Life Science Library
Chemistry

B) Filmstrips: Pictorial Chemistry

Reference:
Navarra, et. al.
pp. 39,40

A) Expected Outcome
Evaluation B) Testing Program

A)
1. Changes from living matter to non-living matter
2. Processes described in the language of the chemist, matter, mass, weight, and inertia.

B) Student
(See evaluation this guide "Perceiving Things")

Teacher
1. Note the accuracy of observations.
2. Assess competency in recording data.
3. Note judgments in interpreting data
4. Assess ability in formulating pertinent data.
5. Assess ability of thought and discussion.

Concepts	A) Teaching Methods B) Learning Activities
5. A molecule is the smallest whole piece of a particular substance; there are molecules of elements and molecules of compounds. E. Changes in Matter 1. A physical change alters the state, shape, size, position, or other observable properties of matter, but it does not affect the make-up of the substance. 2. A chemical change produces new substances; the original substance turns into something else when it undergoes a chemical change.	
Living Matter A. Introduction B. Protoplasm 1. Protoplasm is living matter. 2. As living matter, protoplasm is always changing; it is not a definite, fixed substance. 3. Protoplasm consists mostly of water; it also contains mineral solids and carbon compounds. C. Carbon Compounds 1. A chemical bond joins the atoms that make up a molecule. 2. Atoms either transfer electrons or share electrons to form a chemical bond. 3. Carbon joins readily with other elements because the carbon atom can form four bonds. 4. Organic chemistry is the study of carbon compounds.	A) Suggestion, Discussion 1. Suggest to your students that they read "For Perceiving and Learning." 2. Students to define protoplasm. 3. Refer to sources other than textbooks. 4. Test for sugar with Benedict's Solution. 5. Learning Packet (teacher prepared) B) 1. Observation of protoplasm. 2. Structural formulas of organic chemistry.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) Food And Life Ames and Wyler Great Nutrition Puzzle Callahan	A) 1. Development of experimental skills. 2. The chemical analysis of milk. B) Student (See evaluation this guide "Perceiving Things") Teacher 1. The purpose of the investigation. 2. Recognize the total design of the investigation. 3. Note the accuracy of observation.

Concepts

A) Teaching Methods
B) Learning Activities

D. Proteins
   1. About 15 per cent of protoplasm consists of protein.
   2. Proteins are body builders; they are a necessary part of the diet.
   3. Proteins are made up of amino acids.
   4. Nucleic acids control biochemical reactions within the cell.

E. Carbohydrates
   1. There are two kinds of carbohydrates: sugar and starch.
   2. All carbohydrates are made up of carbon, hydrogen, and oxygen.
   3. Carbohydrates release energy when they break down in the digestive process.
   4. Sugars and starches are fuel nutrients.

F. Fats
   1. About 13 per cent of protoplasm is made up of fats.
   2. Energy is released when fat is broken down in the digestive process.
   3. Fat is a fuel nutrient.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

S m 123

Concepts

The Living Cell

A. Introduction
   1. One of the most important theories of science is the cell theory.
   2. The cell theory is a statement that all living things are composed of cells; cells are the "building blocks" of living things.

B. Parts of the Cell
   1. All cells differ from one another, but there are also basic similarities among cells.
   2. Being alive, a cell is never at rest; it is a changing, reacting unit of a living thing.
   3. Every cell consists of two basic subdivisions: the nucleus and the cytoplasm.

C. Size and Shape
   1. Cells tend to be spherical, but they are usually jammed together and flattened.
   2. Most cells are small; the relationship between the nucleus and the cytoplasm seems to limit their growth.
   3. Large organisms do not as a rule have larger cells than do small organisms; large organisms simply have more cells than do small ones.

D. Observing the Cell
   1. Cytology is a study of the cell.
   2. The cytologist employs various methods and tools in his study of the cell.
   3. An electron microscope forms an image with electrons instead of with light waves.

A) Teaching Methods
B) Learning Activities

A) Suggestion
   1. The relationships of structure and function of cells.
   2. Learning Packet (teacher prepared)

B) Observing the cell.

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Learning Center
A) Cells
You And Your Cells, Schneider

B) Filmstrips:
Biolab Techniques

Reference:
Navarra, et. al.
pp. 72, 73, 74

Evaluation
A) Expected Outcome
B) Testing Program

A) Objectives
1. Cells that are everchanging.
2. Factors that promote the growth of yeast.
3. Chemical analysis of the cell.

B) Student
(See evaluation this guide "Perceiving Things")

Teacher
1. Ability to read illustrations.
2. Observe the students skills in performing experiments.

Concepts

Cell Organization

A. Introduction

B. One-celled Organization
   1. The world of living things consists largely of microorganisms.
   2. A one-celled organism is not necessarily simple in structure and function; it may have achieved a high level of organization.
   3. Some one-celled organisms exhibit little internal specialization; others are highly specialized.
   4. Microorganisms can easily be cultured and observed.

C. Many-celled Organisms
   1. Many lower forms of life are many-celled; all higher forms of life are many-celled.
   2. The cells of higher forms of life are grouped into three levels of structure and function: (1) tissues, (2) organs, and (3) systems.

D. Kinds of Tissues
   1. There are five basic kinds of tissues in the higher organisms: (1) epithelial, (2) muscle, (3) connective, (4) nerve, and (5) blood.
   2. Some of the five main kinds of tissues are further divided into subtypes.

A) Teaching Methods
B) Learning Activities

A) Stress, Review, Discussion
   1. Cells are structural units.
   2. Review bacteria, fungi, algae, and protozoans.
   3. Call attention to the drawings and photomicrographs of paramecium and ameba.
   4. Organization of complex organisms.
   5. Learning Packet (teacher prepared)

B) 1. Students observe samples of tissue under the microscope.
   2. Observation of bone slides and the haversian system.

A) Printed
B) Audio Visual
Resources C) People
D) Places

Learning Center
A) Cells
You and Your Cells
Schneider

Reference:
Navarra, et. al.
pp. 90, 91, 92

A) Expected Outcome
Evaluation B) Testing Program

A) 1. Opportunity to study the cell organization of another plant in the fungi group, the bread mold.

B) Student
See evaluation this guide "Perceiving Things")

Teacher
1. Assess the ability to make comparisons.
2. Note the accuracy of observations.
3. Assess competency in recording data.

Concepts

A) Teaching Methods
B) Learning Activities

Living Things

Classifying Living Things

A. Introduction
B. Classifying Organisms
   1. Modern classification divides living things into three kingdoms: the animal kingdom, the plant kingdom, and the protist kingdom.
   2. There are seven levels of classification: kingdom, phylum, class, order, family, genus, species.
C. The Seven Levels
   1. A phylum is a large subdivision of a kingdom.
   2. Organisms within a phylum are similar in structure, function, and development.
   3. Living things within a phylum are further divided into orders, families, genera, and species.

A) Discussion, Stress
   1. Cite examples of classification in relation to everyday examples.
   2. Stress the importance of the phylum.
   3. Learning Packet (teacher prepared)

B) Associate a common plant or animal with each phyla.

Protist

A. Introduction
B. Protozoans
   1. Taxonomists place the protozoans in four phyla-phylum Sarcodina, phylum Mastigophora, phylum Ciliophora, phylum Sporozoa.
   2. The protozoans in the various phyla move in different ways.
   3. Locomotion is one way to classify protozoans.
C. Phylum Schizomycetes
   1. There are three kinds of bacteria: cocci, bacilli, spirilla.
   2. Bacteria adapt readily to various environments.
   3. Some bacteria are harmful; others are helpful.
   4. Spirochetes and rickettsias are similar to bacteria.

A) Clarify misconceptions, Stress, Involvement
   1. Clarify students understanding of classification.
   2. Stress the difference in the movement of these animals.
   3. Involve the entire class in a compilation of a table of protists.
   4. Learning Packet (teacher prepared)

B) Microorganisms under the microscope with stress upon cell organization and diversity among living things.

A) Printed B) Audio Visual Resources C) People D) Places	A) Expected Outcome Evaluation B) Testing Program
Learning Center A) *The Lives of Animals,* Anderson Reference: Navarra, *et. al* pp. 107, 108, 109	A) The techniques of classification of plants and animals. B) Student (See evaluation this guide "Perceiving Things") Teacher Note judgments in formulating pertinent data.
Learning Center A) *Exploring with your Microscope* *Through the Microscope,* Anderson *Bioluminescence*, Klein *Story of Microbes,* Schatz, Harper, 1952 Reference: Navarra, *et. al*. pp. 122, 123, 124	A) 1. Single-cell animals in a drop of pond water. 2. Classification is based upon differences. 3. Protist a third dimension to the animal group. B) Student (See evaluation this guide "Perceiving Things") Teacher 1. Note the accuracy of observations. 2. Note judgments in interpreting data.

Concepts	A) Teaching Methods B) Learning Activities
D. Slime Molds 1. A slime mold undergoes a metamorphosis. 2. Slime molds reproduce by means of spores. E. Viruses 1. Viruses are tiny; they cannot be seen with an ordinary light microscope. 2. Scientists do not know whether they should classify viruses as living things or as nonliving things. 3. A virus takes on the property of a living thing only when it is lodged within the living cell of a host organism. 4. There are three main kinds of viruses: bacteriophages, plant viruses, animal viruses.	
Animals A. Introduction 1. Animals differ from one another in many ways. 2. Animals are alike in some ways. B. Alive, Yet Different 1. Plants and animals both carry on life functions. 2. Among the life functions are growth, motion, irritability, and metabolism. 3. Animals tend to move about; plants do not move from one place to another. 4. Animals have a more responsive nervous system than do plants. 5. Plants make food for themselves; animals are dependent upon plants for their food.	A) Discussion, Comparison, Illustration 1. Refer to the various life functions. 2. Illustrate the most familiar invertebrates and the most familiar vertebrates. 3. Compare likenesses and differences of animals. 4. Learning Packet (teacher prepared) B) Display of various animals.

A) Printed
B) Audio Visual
Resources C) People
D) Places

Learning Center
A) Horses
Strange World of Reptiles, Norman
Fish
Birds
Reptiles
Practical Taxidermy, Moyer, Ronald Press, 1953
Animals Without Backbones Buchsbaum, University of Chicago, 1948
Snakes, Zim, Morrow, 1949
Alligators and Crocodiles, Zim, Morrow, 1952

Reference:
Navarra, et. al.
pp. 149, 150, 151

A) Expected Outcome
Evaluation B) Testing Program

A) Animals in the community and their habitat.

B) Student
(See evaluation this guide "Perceiving Things")

Teacher
1. Observe individual interaction.
2. Assess ability to be critical.
3. Note ability of scientific attitudes.

Concepts

A) Teaching Methods
B) Learning Activities

C. Lower Invertebrates
   1. An invertebrate is an animal without a backbone.
   2. A vertebrate is an animal with a backbone.
   3. The simplest of animals are invertebrates.

D. Moluska
   1. Mollusks have soft bodies.
   2. Mollusks are more complicated in structure and function than the lower vertebrates.
   3. There are three principal classes of mollusks: Pelecypoda, Gastropoda, and Cephalopoda.

E. Arthropods
   1. The phylum Arthropoda is the largest of animal phyla.
   2. Among the arthropods are insects and spiders.
   3. An insect is a six-legged animal with a three-part body.
   4. Spiders are arachnids, not insects.
   5. Such crustaceans as crabs and lobsters are arthropods.

F. Starfish
   1. The starfish and other echinoderms have an advanced development.
   2. Echinoderms have spiny skins and vascular water systems.

G. Animals With Backbones
   1. Animals with backbones are known as vertebrates.
   2. There are five classes of vertebrates: fish, amphibians, reptiles, birds, mammals.
   3. The vertebrates are higher forms of animal life.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

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Concepts	A) Teaching Methods B) Learning Activities
The Human Body Dissectograph A. Introduction B. The Human Body C. Major Systems D. The Body in Review	A) Read, Experiment, Observe, Discover, Discussion 1. Investigation of hormones and endocrinology. 2. Studies of organs, systems, and functions. 3. Illustration of all plates. 4. Introduce terms: anterior posterior dorsal ventral median lateral 5. Learning Packet (teacher prepared) B) Independent summarizing of knowledge of the human body.
Genetics The Study of Heredity A. Introduction 1. Heredity is the passing along of traits from parents to offspring. 2. Genetics is the study of heredity. B. Heredity 1. A gene is a carrier of hereditary traits. 2. The cells of living things carry dominant genes and recessive genes. 3. Genes are found within the chromosomes of cells; chromosomes are within the nucleus.	A) Discussion, Explanation, Illustration 1. Explain DNA; Heredity 2. Refer to the work of geneticist. 3. Urge the study of illustrations of the DNA molecule. 4. Illustrate the chief difference between mitosis and meiosis. 5. Learning Packet (teacher prepared)

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) Atlas of Systematic Human Anatomy Medicine From Microbes: The Story of Antibiotics, Williams Practical Biology At Home, Savory Milestones of Medicine, Fox From Bones To Bodies, Fox Many Human Senses, Froman You and Your Brain, Groch Our Wonderful Eyes, Perry Lifeline: The Story of Your Circulatory System, Schneider Many Human Senses, Froman Reference: Navarra, et. al. pp. 160, 161, 162	A) 1. Discoveries in medicine and anatomy. 2. An understanding of the structure of the body and of the major organs that are parts of the body. B) Student (See evaluation this guide "Perceiving Things") Teacher 1. Assess the ability to observe. 2. Assess the verification of findings.
Reference: Navarra, et. al. pp. 182, 183, 184	A) The heredity of fruit flies. B) Student (See evaluation this guide "Perceiving Things") Teacher 1. Observe the response to curiosity and fascination to the basic principles. 2. Ability to identify a theory.

Concepts

4. A mutation is a change in genetic make-up. As a result of mutation, the offspring differs from its parent in a marked characteristic.

C. DNA, A Master Code
   1. The gene is believed to consist of a DNA molecule.
   2. DNA transmits hereditary information from parent to offspring.
   3. The DNA molecule takes the shape of a double helix, or of a "twisted ladder."
   4. The arrangement of the "rungs" within the DNA ladder spell out the genetic code.
   5. A DNA molecule can break apart and form two new DNA molecules.
   6. DNA dictates all the processes occurring within the plant or animal cell.
   7. Chromosomes are made up of DNA molecules.

D. Cell Division
   1. Mitosis is the division of a single cell into two new cells like the parent cell.
   2. Meiosis is a cell division in which reproductive cells are formed.
   3. The cells formed as a result of meiosis have half the number of chromosomes found in the parent cell.

A) Teaching Methods
B) Learning Activities

B) Diagram of the DNA molecule and its code-carrying property which is identified as a theory.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

Concepts

A) Teaching Methods
B) Learning Activities

Embryology

The Beginning of Life

A. Introduction
  1. An embryo is a living thing - a plant or an animal - in its first stage of development.
  2. All the cells of an organism developed from a single fertilized egg cell.
  3. Embryology is the study of how organisms develop from zygotes (fertilized egg cells).
  4. A growing embryo develops according to its built-in genetic instruction.
  5. A series of orderly changes occurs with an embryo as it grows and develops.

B. Plant Embryology
  1. The main parts of a flower are the sepals, petals, stamens, and pistils.
  2. The stamens and pistils are the reproductive parts of a flower.
  3. A fruit is a ripened ovary.
  4. A plant embryo consists of four major parts: cotyledon, hypocotyl, plumule, and rudimentary root.
  5. A monocotyledon contains only one cotyledon; a dicotyledon contains two cotyledons.

C. Animal Embryology
  1. Many animals pass through three major stages in embryonic development: cleavage, gastrula, and organ-forming.
  2. Cleavage is the splitting, or dividing, of the zygote.
  3. The division of many cells brings about the development of a mature organism.

A) Discussion, Stress
  1. Single germ cell.
  2. Early development of the bird, amphibian, and mammal.
  3. Metamorphosis
  4. Stress the relationship of genetics to embryology.
  5. Gestation periods.
  6. Planets and animals begin life as embryos.
  7. Learning Packet (teacher prepared)

B) Examination of a flower

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) How Scientist Find Out,
Lotspeich
Trees

Reference:
Navarra, et. al.
pp. 197, 198, 199

A) Expected Outcome
Evaluation B) Testing Program

A) 1. The embryology of brine shrimp.
2. Mathematics of genetics.

B) Student
(See evaluation this guide "Perceiving Things")

Teacher
1. Note accuracy of observations.
2. Assess ability in formulating pertinent data.

Concepts

The Chemistry of Living Things

Solutes and Solvents

A. Introduction

B. Solutions
  1. A solution is a mixture composed of individual molecules and atoms.
  2. A solution consists of two parts: a solvent and a solute.

C. Water, A Solvent
  1. Water is an important solvent used for many purposes.
  2. An element tends to be chemically active it its outermost shell is not filled with electrons.
  3. Water is a polar compound; the water molecule carries an electric charge.
  4. There are five general types of solutions: solid into liquid, gas into liquid, gas into gas, liquid into liquid, and solid into solid.

D. Solubility
  1. The solubility of a substance is the specific amount that dissolves in a given volume of a solvent.
  2. A greater amount of the solute is likely to dissolve in a hot solvent than in a cold solvent.
  3. Pressure increases the solubility of gases.
  4. A saturated solution contains all the solute it is capable of holding.
  5. A dilute solution contains a small amount of solute; a concentrated solution contains a large amount of solute.

A) Teaching Methods
B) Learning Activities

A) Explanation, Discussion, Investigation, Review
  1. Biology, Chemistry, and Physics.
  2. Review atomic structure.
  3. Express concentrations of solutions.
  4. References to experiments.
  5. Learning Packet (teacher prepared)

B) Observations and collection of data.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) Chemistry	A) Properties of solutions
B) Filmstrips: Pictorial Chemistry	B) Students (See evaluation this guide "Perceiving Things") Teacher 1. Note accuracy of observations. 2. Assess competency in recording data.
Reference: Navarra, et. al. pp. 216, 217, 218	

Concepts

Solutions in the Body

A. Introduction

B. Colloids

1. A colloid is a dispersion of tiny particles usually larger than molecules.
2. Colloidal particles cannot ordinarily be filtered from the dispersing medium.
3. There are eight kinds of colloidal suspensions: liquid in gas, solid in gas, gas in liquid, liquid in liquid, solid in liquid, gas in solid, liquid in solid, and solid in solid.
4. Man's body is a mass of organized colloids.

C. Diffusion

1. A membrane is a thin layer of tissue that serves as a covering.
2. Solutions can diffuse, or scatter, through membranes; collids do not readily diffuse through membranes.
3. Osmosis is the diffusion through a membrane into another fluid.
4. Absorption is the taking in of a substance by another substance.
5. Adsorption is the clinging of one substance to the surface of another substance.

A) Teaching Methods
B) Learning Activities

A) Discuss
   1. Solutions and their properties.
   2. The Tyndall effect.
   3. Learning Packet (teacher prepared)

B) Devising of a series of experiments.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) Chemistry	A) Comparison of solutions, colloids, and suspensions.
B) Filmstrips: Pictorial Chemistry	B) Student (See evaluation this guide "Perceiving Things")
Reference: Navarra, et. al. pp. 230, 231	Teacher 1. Observe the students skills in experimentation. 2. Assess competency in recording and interpreting data.

Concepts

The Digestion of Foods
A. Introduction
B. Foods and Digestion
  1. Digestion is the chemical change of foods into particles that can be absorbed by the body cells.
  2. Such foods as water and vitamins require no digestion; they diffuse directly into the blood stream.
  3. Fats, proteins, and carbohydrates are broken down through the digestive process; they are broken down into molecules that can diffuse through the intestinal walls.
  4. Hydrolysis is the breaking down of a compound by combining it with water.
  5. An enzyme is a catalyst that speeds the hydrolysis of foods.
  6. Glands produce digestive juices containing enzymes.
C. The Alimentary Canal
  1. The alimentary canal consists of five main parts: the mouth, esophagus, stomach, small intestine, large intestine.
  2. Digestion occurs in the mouth, in the stomach, and in the small intestine.

A) Teaching Methods
B) Learning Activities

A) Demonstration
  1. Artificial digestion of fat and egg white.
  2. Learning Packet (teacher prepared)

B) Practical on the digestive system of a fish.

A) Printed
B) Audio Visual
Resources C) People
D) Places

A) Expected Outcome
Evaluation B) Testing Program

Learning Center
A) Practical Biology at Home, Savory
Food and Life

Reference:
Navarra, et. al.
pp. 245, 246

S m 145

Concepts

The Living Biosphere
Basic Elements of Ecology

A. Introduction
   1. Ecology is the study of the interrelationships of living things to their environment and to each other.
   2. All living things interact with the nonliving things of their environment.

B. The Biosphere
   1. Living things and their environment are interdependent.
   2. The biosphere is the layer of living matter spanning the earth from within its crust to its upper atmosphere.
   3. Great variety exists among living organisms.
   4. Every plant and animal is dependent in some way on other living organisms.
   5. The highest level in the organization of living things represents a web of life.

C. Producers and Consumers
   1. An interplay of matter and energy holds the web of life together.
   2. Plants are the food-makers; animals are the consumers.
   3. Green plants manufacture food by achieving photosynthesis.

D. Ecological Niche
   1. Animals within the biosphere fall into a niche, or job; a niche represents a way of living.
   2. A niche reflects an animal's adaptation to its environment.

E. Cycles Within the Biosphere
   1. Various cycles within the biosphere are a part of the interrelationships among living things and their environment.
   2. Among the important cycles are the carbon cycle, the water cycle, and the calcium cycle.

A) Teaching Methods
B) Learning Activities

A) Discussion, Comparison
   1. Test a soil sample.
   2. The Biosphere
   3. Compare the work of the ecologist to that of the geologist, meteorologist, and the oceanographer.
   4. Niches are basic to a plant and animal community and are highly specialized.
   5. Explore the relationships among living things and the physical conditions of the biosphere.
   6. Learning Packet (teacher prepared)

B) Reporting on producers and consumers.

A) Printed
B) Audio Visual
Resources C) People
D) Places

Learning Center
A) Living Community, Hirsch

Reference:
Navarra, et. al.
pp. 264, 265

A) Expected Outcome
Evaluation B) Testing Program

A) Ecological Succession

B) Student
(See evaluation this guide "Perceiving Things")

Teacher
1. Assess accuracy of observations.
2. Competency in recording data.
3. Ability to formulate pertinent data.

Concepts

The Biotic Community

A. Introduction
  1. Plants and animals living together in the same environment form a biotic community.
  2. The interaction between living things and the non-living things of their environment represents a pattern of activity known as an ecosystem.

B. Life and the Ecosystem
  1. There is an interplay of matter, energy, and life within an ecosystem.
  2. There are aquatic communities and terrestrial communities.
  3. One species usually dominates the other species within a community.

C. Food For Living Things
  1. Living things interact with one another in their efforts to obtain food.
  2. The food-getting relationships among the living things of a community are intricately joined together in a food web.

D. Friend or Enemy
  1. Some relationships among living things are helpful to the individual organisms and to the community.
  2. Some relationships among living things are harmful to individuals; relationships which harm an individual organism can be helpful to a community.

E. Succession
  1. Succession occurs when the balance in nature is upset.
  2. There are two kinds of succession: primary succession and secondary succession.

A) Teaching Methods
B) Learning Activities

A) Impression, Educational Excursions, Discussion
  1. A community is a group of living things.
  2. Food habits of various living things.
  3. Three forms of symbiosis.
  4. Work of the conservationist.
  5. Learning Packet (teacher prepared)

B) 1. Explore plant and animal communities.
  2. Communities of living organisms in own locality.

A) Printed B) Audio Visual Resources C) People D) Places	A) Expected Outcome Evaluation B) Testing Program
Learning Center A) Living Community, Hirsch Wonders of the Aquarium, Lavine, Dodd-Mead, 1956	A) A pond, a biotic community
	B) Student (See evaluation this guide "Perceiving Things")
Reference: Navarra, et. al. pp. 278, 279, 280	Teacher Note the accuracy of observations.

Concepts	A) Teaching Methods B) Learning Activities
F. Community Laws 1. Adaptation, succession, and multiplication all contribute to the survival of living things. 2. A community cannot survive without a balance in nature. G. Man and the Community 1. Natural resources are either renewable or non-renewable. 2. Man seeks to protect our natural resources.	
Biology in Space Space and Ecology A. Introduction B. The Concept of Space 1. Distances beyond the solar system are measured in light-years instead of in miles. 2. Space is not empty; it contains radiation, atomic particles, and magnetic fields. C. Radiation, A Problem 1. Radiation is constantly streaming through space. 2. A band of particles known as the magnetosphere surrounds the earth. D. Man in Space 1. An earthlike environment is necessary for the vurvival of man in space. 2. Weightlessness is one of the major problems of space exploration. E. The Search For Life 1. Biologists are exploring the possibility of extraterrestrial life. 2. A knowledge of physics and biochemistry has been applied to the development of life-detection instruments.	A) Stress, Explanation, Illustration 1. Contributions that the biologist and the ecologist have made toward manned space flight. 2. Use of current events. 3. Electromagnetic spectrum. 4. Role of biologist and ecologist have made in space exploration. 5. Learning Packet (teacher prepared) B) Summary of investigations of space flight, radiation and other hazards.

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Learning Center A) America's Explorers of Space Survival on the Moon, Maisak Space Pioneers, Norton Going into Space, Clarke Into Space with the Astronauts The Wonders of Space Rockets and Missles Satellites, Rockets, and Outer Space, Ley	A) Space exploration B) Student (See evaluation this guide "Perceiving Things") Teacher Note accuracy of observations.
Reference: Navarra, et. al. pp. 294, 295, 296	

Concepts	A) Teaching Methods B) Learning Activities
Life and Survival	
A. Introduction	A) Discussion
B. The Closed Ecological System 1. Man must establish a closed ecological system to survive in space. 2. A balanced aquarium is a closed ecological system.	1. Analogy between the earth and a space ship. 2. Learning Packet (teacher prepared)
C. An Earthly Environment 1. Scientists hope to develop a self-sustaining system for the protection and support of men in space. 2. A life-support system must supply the basic needs of men: water, food, and oxygen.	B) Writing a space story of science fiction.

A) Printed
B) Audio Visual
Resources C) People
D) Places

Learning Center
A) America's Explorers of Space
Survival on the Moon, Maisak
Going into Space, Clarke
Space Pioneers, Norton
Rockets and Missles
Wonders of the Aquarium, Lavine, Dod-Mead, 1956

Reference:
Navarra, et. al.
pp. 305, 306

A) Expected Outcome
Evaluation B) Testing Program

A) 1. U. S. Apollo program.
2. Observation of a closed ecological system.

B) Student
(See evaluation this guide "Perceiving Things")

Teacher
Note accuracy of observations.

READING COMMUNITY SCHOOLS

CURRICULUM GUIDE

SCIENCE

HIGH SCHOOL

9TH YEAR

Quarter	1st	2nd	3rd	4th
BIOLOGY BSCS YELLOW	Introduction Solving Biological Problems Historical Biological Problems Structural Cytology Basic Functions Biochemistry Physiological Cytology Mitosis Meiosis DNA RNA	Virus Bacteria Molds, Yeast, Etc. Algae Mosses And Vascular Plants Leaves And Photosynthesis Roots And Stems Reproduction of Flowering Plants Review Projects Exams	Animals vs. plants Animal Classification Digestion Circulation Or Transportation Respiration Excretion Sensitivity And Coordination Support And Locomotion Reproduction And Embryology	Behavior Ecology Cycles Food Chains Distribution Mankind Heredity Evolution Exams
LIFE SCIENCE	Introduction Cells As Building Units Chemicals As The Building Materials Life Processes Elective Topics	Thallophyta Bryophyta Pteridophyta Spermatophyta Roots Stems Leaves Flowers Fruits, Seeds Projects Exams	Protozoa Porifera Coelenterata Platyhelminthes Nemathelminthes Rotifera Bryozoa Mollusca Annelida Echinodermata Arthropoda	Chordata Vertebrate Classes The Human Body Ecology Elective Topics Exams

S s 1

4th	3rd	2nd	1st	Quarter	
Histology Skeletal System Muscular System Nutrition Digestion Respiration Excretion Circulation Exams	Pisces Amphibia Reptilia Aves Mammalia Anthropology	Mollusca Echinodermata Arthropoda Crustacea Insecta Invertebrates Chordata Projects Exams	Introduction Protozoa Porifera Coelenterata Platyheminthes Nemathelminthes Annelida	ADVANCED BIOLOGY	10TH YEAR
Pre Cambrian Paleozoic Mesozoic Cenozoic Prehistoric Man Atmosphere Air Masses Weather Exams	Destruction Forces Weathering Erosion Construction Forces Diastrophism Vulcanism Conservation Physiographic Provinces Oceans Lakes Oceanography	Minerals Ores Fuels Igneous Rocks Sedimentary Metamorphic Topographic Maps Exams	Metric Measurements Conversions Stars Galaxies Sun Planets Satellites Space Program Earth Moon Seasons Time Location	EARTH SCIENCE	

4th	3rd	2nd	1st	Quarter
Natural Radioactivity Artificial Radioactivity Metals Alkali Metals Nitrogen Oxygen Halogens Exams	Gas Laws Molecular Weight & Volume Relationships of Gases Carbon and Its Oxides Hydrocarbons Organic Compounds	Valence & Bonds Formulas Equations Equations & Weight Solutions - Crystals Ions & Electricity Acids, Bases, Salts Chemical Reactions Projects Exams	Introduction Measurements Conversions Classification Of Matter And Its Changes Atomic Structure Electronic Configuration Periodic Law	11TH YEAR CHEMISTRY
Bohr Plank's Constant Photons Statistical Tech. Radiation Atomic Particles Isotopes Physics Related To Other Sciences Review Elective Topics Exams	Electrical Charge Fields of Force D.C. Current Ohm's Law Mole Concept Electrochemistry A.C. Current Motors Communications Sound Light Optics Reflection Refraction Diffraction Atomics Quantum Theory	Density & S. G. States of Matter Archimedes Prin. Potential & Kinetic Energy Heat & Temperature Gas Laws Specific Heat Calorimetry Equilalent of Heat Engines Review Exams	Introduction Astronomy And Historical Physics Motion Vectors Acceleration Motion & Mass Circular Motion Newton's Laws Acceleration Gravitation Conservation of Mass Momentum	12TH YEAR PHYSICS

Concepts	A) Teaching Methods B) Learning Activities
LIFE SCIENCE	
Unit 1 Introduction	
1. The High School Science Department	Lecture
2. Notebook Rules	Lecture and Sample Notebooks
3. Project Rules	Lecture and Past Projects as Examples
Unit 2 Cells	Read Chapter 1 Lecture, Questions, Discussion Labs: The Microscope Human Cell Types (10)
Unit 3 Chemicals of Life	Read Chapter 2 Lecture, Questions, Discussion Demonstrations: Tests for protein, fats, starches, glucose
Unit 4 Life Processes	Read Chapter 3 Lecture, Questions, Discussion Labs: Observe Living Cultures Under The Microscope; Spirogyra Conjugation Slides
Unit 5 Elective Topics	Teacher offers elective topics for group or groups to choose from and pursue based upon individual interests

Resources A) Printed B) Audio Visual C) People D) Places	A) Expected Outcome B) Testing Program
B) "Safety in the Biology Lab"-F.O.M.	A) Freshmen Science Orientation
B) "Animal Care in the Lab"-F.O.M.	
A) Handout Notes	A) Complete Semester Notebook
A) Handout Notes	A) Complete Semester Project; demonstrate ability to solve scientific problems in an organized manner.
A) Cell Drawings B) Microscopic Slides B) "How Cells Divide"-F.O.M. "Tissue Cultures"-F.O.M. B) "D.N.A. A Key To All Life"-Life B) Cell Model	A) Understand the cell parts, functions and their relationship to the whole organism. B) Test
B) "The Atom"-Life B) "Chromatography in Biological Analysis"-F.O.M.	A) Understand that living matter is made up of non-living matter B) Test
B) "Leeuwenhock"-E.B.F. B) "Life Cycle of a Plant"-E.B.F. B) "Cell Movement"-F.O.M. B) "The Mechanics of Sensation"-F.O.M. A) 10 Life Function Handout Notes	A) Appreciation of the 10 life functions B) Test
A) Biology, Koeber A) Modern Biology, Moon A) Reference Books in Science Dept. A) Library	A) Individual or group shows ability to pursue choosen interests. B) Test(s)

Concepts	A) Teaching Methods B) Learning Activities
LIFE SCIENCE	
Unit 6 Classification Thallophyta Bryophyta	Read Chapter 4 Lecture, Questions, Discussion Labs: Local Fungi, Algae, and Moss Specimens
Unit 7 Pteridophyta Spermatophyta	Read Chapter 5 Lecture, Questions, Discussion Labs: Local and Household Ferns Bean and Corn Seed Dissection Examine other seed specimens
Unit 8 Roots Stems Leaves Flowers Fruits and Seeds	Read Chapter 10 Lecture, Questions, Discussion Labs: Tropism Experiments Geranium Patch Experiment Transpiration Experiment Aquatic Plant-O_2 Experiment Seed Germination
Projects	Each student is given 7 minutes to present his semester project to the class.
Exams	

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
B) "How Plants Are Classified"-E.B.F. B) "Carolus Linnaeus"-E.B.F. B) "Bacteria"-E.B.F. B) "Fungi and Slime Molds"-E.B.F. B) "Algae"-E.B.F. B) "Bryophytes"-E.B.F. B) Preserved Specimens A) Field Guides to Mosses and Ferns, Science Dept.	A) Shows appreciation for the variety of plant sizes, complexities and means of carrying on life activities.
B) "Fern and Fern Allies"-E.B.F. B) "Gymnosperms"-E.B.F. B) "Monocotyledons"-E.B.F. B) "Dicotyledons"-E.B.F. A) Field Guides to Plants, Science Dept.	A) Realize the effects of vascular tissue upon size A) Realize the advantages of the seed B) Test
A) Van Helmont's Experiment in "Great Experiments in Biology" - Science Dept. B) "Roots of Plants"-E.B.F. B) "Stems of Plants"-E.B.F. B) "Leaves of Plants"-E.B.F. B) "Flowers and Fruits"-E.B.F.	A) Appreciate the complexity of the plant and the interrelationship of it's parts. B) Test
A) Project Rules (previously handed out) B) Past Projects (1) models (2) charts (3) 35 mm slides B) Project Books and Pamphlets - Science Dept.	A) The student experiences a challenging and lengthy scientific problem on his own. B) Teacher evaluates the project

LIFE SCIENCE

Concepts	A) Teaching Methods B) Learning Activities
Unit 9 Protozoa	Read Chapter 6 Lecture, Questions, Discussion Labs: Microscope - Protozoa Cultures
Porifera	Lecture, Questions, Discussion Examine Preserved and Commercial Sponges
Coelenterata	Lecture, Questions, Discussion Lab: Hydra Specimens
Platyheminthes	Lecture, Questions, Discussion Lab: Planaria Behavior
Nemathelminthes	Lecture, Questions, Discussion Lab: none
Rotifera Bryozoa	Lecture, Questions, Discussion Labs: Rotifera Culture Bryozoa fossil specimens
Mollusca	Lecture, Questions, Discussion Lab: Clam, optional Read Chapter 7
Echinodermata	Lecture, Questions, Discussion Lab: Starfish, optional
Arthropoda	Read Chapter 8 Lecture, Questions, Discussion Lab: Grasshopper dissection Crayfish, optional

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation B) Testing Program	A) Expected Outcome
B) "How Animals Are Classified"-E.B.F. "The Protozoa"-E.B.F. A) "Fieldguide to Protozoa" - Science Dept. A) "Taxonomic Key to Animals" - Science Dept.	B) Test or Quiz	
B) "Sponges and Coelenterates"- E.B.F. B) Preserved Specimen Collection	B) Test or Quiz	
B) Coral Specimens B) Preserved Specimen Collection	B) Test or Quiz	A) In this lengthy series of units the student should appreciate the phylo-gentic ascent as it applies to structural changes, evolution and compare these to man from each life function aspect.
B) "The Flatworms" B) Preserved Specimen Collection B) Parasite Specimens		
B) "Roundworms"-E.B.F. B) Preserved Specimen Collection B) Parasite Specimens	B) Test or Quiz	
B) Review Minor Phyla portion of "Roundworm" filmstrip-E.B.F.	B) Test or Quiz	
B) "Chitons, Tooth Shells, etc."-E.B.F. B) "Snails and Slugs"-E.B.F. B) Preserved Specimen Collection B) Marine Collection	B) Test or Quiz	
B) "Sea Stars and Their Relatives"-E.B.F. B) Preserved Specimen Collection B) Marine Collection	B) Test or Quiz	
B) "Arachnids, Centipedes, and Millipedes"-E.B.F. B) "The Crustaceans"-E.B.F. B) The Insect Series (12) E.B.F. B) Preserved Specimen Collection	B) Test or Quiz	

LIFE SCIENCE

Concepts	A) Teaching Methods B) Learning Activities
Chordata	Read Chapter 9 Lecture, Questions, Discussion Lab: View Amphioxus Specimens Perch, optional Frog, optional
Unit 10 The Human Body	Read Chapter 12 Lecture, Questions, Discussion Labs: Beef Heart Dissection Beef Lung Dissection Beef Kidney Dissection Beef Liver
Unit 11 Ecology	Read Chapter 24 Lecture, Questions, Discussion Fieldtrip
Elective Topics	Teacher offers elective topics for group or groups to choose from and pursue based upon individual interest.
Exam	

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
B) Skeleton Specimens B) Preserved Specimen Collection B) Classes of Vertebrate Series of E.B.F. Filmstrips	B) Test or Quiz
B) "William Harvey"-E.B.F. B) "Circulatory Control"-F.O.M. B) "Smoking And Health"-F.O.M. B) Torso, Skeleton, Heart, Eye, Ear, Urinary System models C) Specimens can be obtained through a local grocer.	A) Develop an appreciation of ones body realizing that man is the finest of all organisms. B) Test
B) Life Filmstrip Series (6) on Ecology D) Possible Fieldtrip Sites to Consider: School Yard, Sharon Woods, Cincinnati Science Center, Cincinnati Nature Center	A) Appreciate the complexity of the interrelationship of living things.
A) Biology, Kroeber, Science Dept. A) Modern Biology, Moon, Science Dept. A) Reference Books in Science Dept. D) Library	A) An opportunity for an individual or group to pursue choosen interests. B) Test(s)

EARTH SCIENCE

Course Content	A) Teaching Methods B) Learning Activities
Unit I- Measurements and Conversion from the English to Metric System.	A) Lecture Discussion Instruments of measure B) "Specific Gravity"
Unit II- Astronomy	
A. Stars and Galaxies The Sun and Its Planets	A) Lecture Discussion Use of planetarium B) "Solar System
B. Satellites and U.S. Space Program	A) Lecture Discussion B) "Plotting Orbits of Man-Made Satellites" "Orbit Velocity of an Earth Satellite"
C. Earth and the Moon	A) Lecture Discussion Planetarium B) "Phases of Moon" "Eclipses of Moon and Sun"
D. Earth's Motions, Seasons Time and Location.	A) Lecture Discussion Planetarium B) "The Seasons" "Location and Time on Globe" "Problems in Longitude and Time" "Standard Time"

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
A) Problems on conversion using the factor-lable method.	B) Quiz Test A) A useful command of the metric system
A) "The Solar System, A Guide to the Nine Planets" U.S. Air Force	B) Quizzes Test
B) "Our Mr. Sun" C. and S. Bell Telephone "Man Becomes An Astronomer" EBF= Encyclopedia Britannia Filmstrips "Tho Starry Universe" - Life "The Sun's Awesome Impact" - Life	A) An appreciation of our universe and its influence upon man
B) "Man Learns To Fly" "Man in Flight" "Man in Space" EBF "Flight into Space" "Flight to Mars"	B) Quiz Test
B) "Man and the Moon" EBF "Flight around the Moon"	B) Quiz Test
B) Relief Globe of Earth	B) Quizzes Test A) To appreciate how the earth's position effects man's environment

EARTH SCIENCE

Course Content	A) Teaching Methods B) Learning Activities
Unit III- Earth and Its Land Forms	
A. Minerals, Ores and Fuels	A) Lecture Discussion Samples of minerals and ores Demonstrations: 1) Geiger-Muller Counter Radioactive minerals 2) Fluorescent minerals 3) Gem minerals B) Mineral Sets- Wards "Hardness Scale of Minerals" "Properties of Rock-Forming Minerals" "Important Metallic Minerals" "Important Non-metallic Minerals"
B. Rocks	A) Lecture Discussion Rock Samples B) "Igneous Rocks" "Sedimentary Rocks" "Metamorphic Rocks" Combined study and review of all rocks and minerals.
C. Topographic Maps	A) Lecture Discussion Demonstrations-Use of Sand to show Bending of Contour Lines. B) "Introduction to Contour Maps" "Reading a Topographic Map"
D. Destruction Forces Weathering and Erosion	A) Lecture Discussion Demonstration-"Hard and Soft Water" B) "Action of Ground Water" "Great Rivers of the U.S." "Flood Plains and Bluffs" "Profiles of Rivers" "Action of Wind" "Glaciated Region" "Shore Features" "Flood Plains, Levees & Swamps"

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
A) "Petroleum Pamphlet and Charts"- American Petroleum Institute B) "Oil From The Earth To You"- American Petroleum Institute "How Steel Is Made" U.S. Steel Corp. "Ohio Mineral Resources" Standard Oil Co. "The Not So Solid Earth"-Life "The Minerals"-Wards "Identification of Minerals"-Wards	B) Quizzes Test A) To identify specimens of minerals and ores
A) Chart on Types of Rocks and Their Relationships. B) "The Rocks"-Wards "Igneous Rocks"-Wards "Sedimentary Rocks"-Wards "Metamorphic Rocks"-Wards	B) Quizzes Test Practical Lab Test on the Identification of Rocks and Minerals.
A) Topographic Maps- United States Geological Survey. Chart on Maps	B) Quizzes Test A) To be able to analyze maps
B) "Weathering & Erosion"-Wards "Streams & Rivers"-Wards "Glaciers"-Wards	B) Quizzes Tests

Course Content	A) Teaching Methods B) Learning Activities
EARTH SCIENCE	
E. Constructional Forces Diastrophism and Volcanism	A) Lecture Discussion Models B) "Plateau" "Folded Mountains" "Fault and Block Mountains" "A Volcano"
F. Conservation and The Physiographic Provinces	A) Lecture Discussion B) "Physiographic Features of the U.S."
Unit IV- Oceans and Lakes Oceanography	A) Lecture Discussion B) "Ocean Currents"
Unit V- Historical Geology	
A. Pre-Cambrian Time	A) Lecture Discussion B) "Study of Period Fossils"
B. Paleozoic and Mesozoic Eras	A) Lecture Discussion B) "Study of Period Fossils"
C. Cenozoic Era and Prehistoric Man	A) Lecture Discussion B) "Study of Period Fossils"
Unit VI- Atmosphere Nature of Atmosphere Air Masses and Weather	A) Lecture Discussion Demonstrations 1) Atmospheric Pressure 2) Convection Currents 3) Thermometers 4) Barometers B) "Distribution of Insolation" "Absorption and Radiation" "Relation of Altitude to Atmospheric Pressure" "Dew Point"

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
B) "Volcanism"-Wards "Mountains"-Wards	B) Quizzes Tests A) Show appreciation for the constantly opposing forces at work upon the earth.
B) "Cloud over Ohio" Standard Oil Co.	B) Quizzes Tests
B) Hydrographic Globe of Earth "Lakes and Oceans"-Wards "Project Mohole-Phase One" American Petroleum Institute "The Miracle of the Sea"-Life	B) Quiz Test AO Show an understanding of the expanse of the earth's watery surface and the wealth and opportunity that lies within.
B) "The Earth Is Born"-Life "Discovering Fossils"-EBF "The Story Fossils Tell"-EBF	B) Quiz Test
B) "The Coming of Reptiles"-EBF "The Rise of Dinosaurs"-EBF "Triumph of Dinosaurs"-EBF	B) Quiz Test A) Show an understanding of the physical and biological trends throughout the earth's eras.
B) "Age of Mammals"-EBF "Man Inherits The Earth"-Life "Stone Age People Of Today"-Life	B) Quiz Test
	B) Quizzes Tests A) Have a working knowledge of the atmosphere's influence upon man and how he attempts to predict, utilize and control it.

BIOLOGY, B.S.C.S. YELLOW

Course Content	A) Teaching Methods B) Learning Activities
Unit 1 Introduction	
1. High School Science Department	Lecture
2. Notebook Rules	Lecture and Example Notebooks
3. Drawing Rules	Lecture
4. Project Rules	Lecture and Past Projects
5. Branches of Science	Lecture
Unit 2 Solving Biological Problems	Questions on Student Interpretations of Chapter 1
Unit 3 Historical Biological Problems	Read Chapter 2 Discussion, Questions Selected Readings Lab: Spontaneous Generation
Unit 4 Structural Cytology	Read Chapter 3 Lecture, Discussion, Questions Selected Readings Labs, The Microscope Student Pigment Charts
Unit 5 Basic Functions	Read Chapter 4 Selected Readings Discussion, Questions

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
B) "Safety in the Biology Laboratory" F.O.M. A) Handout Notes (2) A) Handout Notes (2) A) Handout Notes (1) A) Handout Notes (1)	A) Demonstrate an understanding of freshmen science program A) Complete Semester Notebook A) Complete Semester Project A) Identify Potential Occupations
B) "Origin of Living Things"-F.O.M.	A) Solve selected biological problems
A) "Great Experiments in Biology" p. 106,110,187,189 Paperback Prentice-Hall A) "Frontiers of Biology" Paperback B) "Pasteur"-E.B.F. "Leeuwenhock"-E.B.F.	A) Show an appreciation of previously solved biological problems B) Test
A) "Great Experiments in Biology" p. 3, 6, 9, 12. A) "Scientific American", Sept. 61 A) Life & Properties Notes (1) A) Protoplasm Notes (1) A) Cell Drawings (3) B) Cell Model B) "Tissue Culture"-F.O.M.	A) Realize that the cell is the basic unit of life. A) Operation and understanding of efficient microscopic technique. B) Test
A) "Great Experiments in Biology" p. 155	A) Understand selected basic principles of science B) Test

BIOLOGY, B.S.C.D. YELLOW

Course Content	A) Teaching Methods B) Learning Activities
Unit 6 Biochemistry	Read Chapter 5 Discussion Lecture Demonstration Tests for: protein, fats, starches, glucose
Unit 7 Physiological Cytology	Read Chapter 6 Lecture, Discussion, Questions Labs: Cell and Its Parts
Unit 8 Mitosis Meiosis	Read Chapter 7 Lecture, Disucssion, Questions Labs: Cell Reproduction
Unit 9 DNA RNA	Read Chapter 8 Lecture, Discussion, Questions
Unit 10 Virus	Read Chapter 9 Lecture, Discussion, Questions
Unit 11 Bacteria	Read Chapters 10 & 11 Lecture, Discussion, Questions Labs: Bacteria
Unit 12 Mold, Yeast and Microbes	Read Chapter 12 Lecture, Discussion, Questions Labs: Fungi

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
A) Handout Notes (5) B) Photosynthesis Model B) "Chromatography in Biological Analysis"-F.O.M. B) "The Atom"-Life	A) Comprehend that living matter is composed of non-living matter B) Test
A) Cell Drawing Handout Notes A) "Scientific American" Sept. 1961 B) "Cracking The Code of Life" American Cancer Society Movie	A) Appreciate the complexity of the cell although its the basic unit of structure. B) Test
B) Microscope Slides B) "Maturation of Gametes"-F.O.M. B) "How Cells Divide"-F.O.M.	A) Demonstrate understanding of idea that life begets life. A) Understand necessity of reduction division. B) Test
B) "Investigations into Bacterial Heredity"-F.O.M. B) "DNA - A Key To All Life"-Life	A) Appreciation of the complexity of inheritance B) Test
B) "The Virus: New Discoveries" F.O.M. "Origin of Living Things"-F.O.M.	A) Are viruses the threshold of life? B) Test
B) Bacterial Microscope Slides "Bacteria"-E.B.F.	A) Understand the nature of diseases and their treatments. B) Test
B) "How Plants Are Classified"-E.B.F. B) "Fungi And Slime Molds"-E.B.F.	B) Test

BIOLOGY, B.S.C.S. YELLOW

Course Content	A) Teaching Methods B) Learning Activities
Unit 13 Algae	Read Chapter 13 Lecture, Discussion, Questions Lab: Algae
Unit 14 Mosses And Vascular Plants	Read Chapter 14 Lecture, Discussion, Questions Labs: Mosses, Ferns
Unit 15 Leaves And Photosynthesis	Read Chapter 15 Lecture, Discussion, Questions Bulletin Board Labs: Leaves
Unit 16 Roots And Stems	Read Chapter 16 Lecture, Discussion, Questions Lab: Roots and Stems
Unit 17 Reproduction And Development Of Flowering Plants	Read Chapter 17 Lecture, Discussion, Questions Labs: Flowers, Seeds
Review	

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
B) Microscope Slides B) "Algae"-E.B.F.	A) Understand concept of the trend towards complexity in green plants. B) Test
B) "Bryophytes"-E.B.F. "Ferns and Allies"-E.B.F. "Gymnosperms"-E.B.F. "Monocotyledons"-E.B.F. "Dicotyledons"-E.B.F.	A) Asexual reporduction and the significance of the seed from "trends" standpoint. B) Test
A) Leaf Drawings B) "Leaves of Plants"-E.B.F. B) Leaf Model B) Photosynthesis Model	A) See biochemical relationship between leaf structure, energy and food B) Test
B) Root Tip Model B) "Roots of Plants"-E.B.F. "Stems of Plants"-E.B.F. A) Stem Tropism Handout Drawings (4) A) Root and Stem Handout Drawings (4)	A) Show understanding of absorption and conduction aspects. B) Test
A) Flower and See Handout Drawings (4) B) "Flowers and Seeds"-E.B.F.	A) Demonstrate knowledge of the value of the seed and hormone effects. B) Test

BIOLOGY, B.S.C.S. YELLOW

Course Content	A) Teaching Methods B) Learning Activities
Projects	Each student is given 7 minutes to present his semester project to the class.
Midterm Exam	
Unit 18 Animals Compared to Plants	Read Chapter 18 Lecture, Discussion, Questions Lab: None
Unit 19 Classification of Animals	Read Chapter 19 Lecture, Discussion, Questions
Unit 20 Digestion	Read Chapter 20 Lecture, Discussion, Questions Demonstrations of Enzyme Actions
Unit 21 Circulation And Transportation	Read Chapter 21 Lecture, Discussion, Questions Labs (3) and Microscopic Slides

Resources
A) Printed
B) Audio Visual
C) People
D) Places

Evaluation
A) Expected Outcome
B) Testing Program

A) Project Rules (previously handed out) B) Past Projects 1. models 2. charts 3. 35mm slides B) Project books and pamphlets from Science Dept. Collection.	A) The student experiences a challenging and lengthy scientific problem on his own. B) Teacher evaluates the project.
A) 10 Life Function Handout Notes B) "Homeostatic Relations"-F.O.M.	A) Demonstrate the similarities and differences between plants and animals. A) Understand Homeostasis B) Test
A) Handout Sheets on Taxonomy B) "Carolus Linnaeus"-E.B.F. B) "How Animals are Classified"-E.B.F B) Preserved Specimen Collection	A) Appreciate the phylogenetic ascent. B) Test
A) Digestion Handout Drawing B) Torso	A) Understand the chemical aspects of digestion. B) Test
B) "William Harvey"-E.B.F. B) "Circulatory Control"-F.O.M. B) Torso B) Heart Model B) Microscopic Slides of Blood	A) Realize the necessity of circulation to size of organism. B) Test

BIOLOGY, B.S.C.S. YELLOW

Course Content	A) Teaching Method B) Learning Activities
Unit 22 Respiration	Read Chapter 22 Lecture, Discussion, Questions Lab: (1) Lung Dissection
Unit 23 Excretion	Read Chapter 23 Lecture, Discussion, Questions Lab: (1)
Unit 24 Sensitivity And Coordination	Read Chapter 24 Lecture, Discussion, Questions Lab: (1)
Unit 25 Support And Locomotion	Read Chapter 25 Lecture, Discussion, Questions Lab: Microscope
Unit 26 Reproduction And Embryology	Read Chapters 26, 27, 28 Lecture, Discussion, Questions Labs: Microscope
Unit 27 Behavior	Read Chapter 35 Lecture, Discussion, Questions Lab: Maze Observations Aquarium Observations

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
B) "Smoking And Health"-F.O.M. B) Torso D) Obtain lung specimen from grocer	A) Understand the difference between breathing and respiration and principles of each. B) Test
B) Torso B) Urinary Model B) Review "Homeostatic Control"-F.O.M.	A) Show appreciation of the Necessity of excretory structures increasing in complexity as organisms do. B) Test
B) "Photoperiodism In Animals"-F.O.M. B) "The Mechanics of Sensation"-F.O.M. B) Torso B) Skull and Brain B) Microscopic Slides of Nerve Cells	A) Show comprehension of the value of the nervous system to the complexity of an organism. B) Test
B) Skeleton and Muscle Charts B) "Cell Movement"-F.O.M. B) Microscope Slides, 3 muscle cell types	A) Demonstrate understanding of the trends in locomotion; the bone muscle relationship.
B) Zygote Formation Models B) Chick Embryo Specimens	A) Outline different methods of reproduction and stages of embryo development.
B) Observe: Fish in Aquarium B) Observe: Rat or Mouse Maze B) "Biological Societies"-F.O.M.	A) Show understanding of various behavior ranges, complexity, and problems involved. B) Test

BIOLOGY, B.S.C.S. YELLOW

Course Content	A) Teaching Methods B) Learning Activities
Unit 28 Ecology Cycles Food Chains Distribution	Read Chapters 36 and 37 Lecture, Discussion, Questions Labs
Unit 29 Mankind	Read Chapter 38 Lecture, Discussion, Questions
Unit 30 Heredity	Read Chapters 29 and 30 Lecture, Discussion, Questions Labs: Heredity Heredity Problem Charts
Unit 31 Evolution	Read Chapters 31, 32, 33 Lecture, Discussion, Questions Labs: None
Exams	

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
A) Ecology Handout Notes B) "Life In The Ocean"-F.O.M. "The Miracle of The Sea"-Life "The Coral Reef"-Life "The Woods of Home"-Life "The Desert"-Life "The Tundra"-Life "The Rain Forest"-Life	A) Demonstrate appreciation for the complexity of the interrelationships of living things. B) Tests (2)
B) "Man Inherits The Earth"-Life "Stone Age People Of Today"-Life "Evolution Today"-Life "Anthropology"-F.O.M.	A) Demonstrate appreciation for the magnitude of man's problems. B) Tests
B) "Gregor Mendel"-E.B.F. B) Review "Investigations Into Bacterial Heredity"-F.O.M.	A) Show comprehension of the mechanics, results and significance of heredity. B) Test (2)
B) "Charles Darwin"-E.B.F. See the E.B.F. series of 6 filmstrips involving prehistoric life. See filmstrips under Unit 29	A) Detail the factors underlying evolution, variations, and anthropology.

ADVANCED BIOLOGY

Course Content	A) Teaching Methods B) Learning Activities
This course is a 10th grade elective but is highly recommended to be part of all academic or college bound students. The prerequisite is Biology and instructor approval. The course is one credit, five periods per week. The first semester deals with the lower animals, zoology and the second semester with man, to include anthropology, anatomy and physiology.	The basic theme of the course is to help the student to fully appreciate his fine body and mind by comparing himself to lower forms studied within the phylo-genetic ascent of this course.
Unit I INTRODUCTION	
1. Introduction	Lecture
2. Review 10 Life Functions	Lecture
3. Origin of Life.	Lecture Reference
Unit II PHYLUM PROTOZOA	Lecture Lab: Ameba Paramecium Euglena Stentor
Unit III PHYLUM PORIFERA and PHYLUM COELENTERATA	Lecture Lab: Hydra Preserved Specimens
Unit IV PHYLUM PLATYHELMINTHES	Lecture Lab: Planaria Tropisms Preserved Specimens

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Handout Notes Handout Notes (1) Test and AWB Chapter #1 "Origin of Life" Filmstrip-F.O.M. "Virus" Filmstrip-F.O.M.	Student Orientation 10 Life Function Quiz Origin of Life Quiz
Handout Notes (3) Filmstrip -"Protozoa"- EBF Protozoa Drawing	Chapter #3 AWB Quiz Chapter #5 AWB Quiz Protozoa Test A) Develop an understanding of protozoa as the basis of animal life, land formers, and parasites
Handout Notes (5) Filmstrip "Porifera and Coelenterata"- EBF Sponge Drawing Hydra Drawing	Porifera and Coelenterata Test A) Show the specialization of cells and its effects on higher phyla
Handout Notes (3) Filmstrip "The Flatworms"- EBF Planaria Drawing Fluke Cycle Drawing	Chapter #10 AWB Quiz Chapter #11 and 12 AWB Quiz Platyhelminthes Test A) Understand the complexity and involvement of parasites A) Emphasize the appearance of organs and systems and its impact on higher phyla

ADVANCED BIOLOGY

Course Content	A) Teaching Methods B) Learning Activities
Unit V PHYLUM NEMATHELMINTHES	Lecture Lab: None Preserved Specimen
PHYLUM ANNELIDA	Lecture Lab: Earthworm Preserved Specimens
Unit VI PHYLUM MOLLUSCA	Lecture Lab: Clam Shell Collection Preserved Specimen
Unit VII PHYLUM ECHINODERMATA	Lecture Lab: Starfish Preserved Specimens
Unit VIII PHYLUM ARTHROPODA	Lecture Lab: Grasshopper Crayfish Insect Collection Preserved Specimens
Unit IX INVERTEBRATE CHORDATES	Lecture Lab: Amphioxus Preserved Specimens

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Handout Notes (1) Filmstrip: "Roundworms"- EBF	Roundworm Quiz A) Emphasize principles of parasitology
Handout Notes (3) Filmstrip: "Segmented Worms"- EBF Earthworm Drawing	Earthworm Drawing Quiz Annelida Quiz Roundworm and Annelida Test
Handout Notes (3) Filmstrip: "Snails and Slugs"- EBF "Chitons and Clams" - EBF Clam Drawing	Clam Drawing Quiz Mollusca Test
Handout Notes (3) Filmstrip: "Starfish and Relatives"- EBF Starfish Drawing	Starfish Drawing Quiz Echinodermata Test
Handout Notes Filmstrips: (14 EBF) 4 on Insects 8 on Insects Orders 1 on Arachnids etc. 1 on Crustaceans Crayfish Drawing (1) Grasshopper Drawing (2)	Chapter 24 Text Quiz #1 Chapter 22 AWB Quiz #2 Chapter 25 Text Quiz #3 Chapter 26 Text Quiz #4 Chapter 23 AWB Quiz #5 Crayfish Drawing Quiz #6 Grasshopper Drawing Quiz #7 Arthropoda Test
Handout Notes (2) Filmstrip: None Amphioxus Drawing Classes Drawing	Amphioxus Drawing Quiz Invertebrate Chordate Test

Course Content	A) Teaching Methods B) Learning Activities

ADVANCED BIOLOGY

PROJECT WEEK: Each student gives a 7 minute presentation to the class. The top ten in each course goes to the Reading High School Science Fair.	
EXAM WEEK	
Unit X CLASS PISCES	Lecture Lab: Yellow Perch Preserved Specimens Fish Bulletin Board
Unit XI CLASS AMPHIBIA	Lecture Lab: Frog Plastic Specimens Preserved Specimens
Unit XII CLASS REPTILIA	Lecture Lab: None Preserved Specimens
Unit XIII CLASS AVES	Lecture Bulletin Board Lab: None

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Handout Notes (3) Filmstrips: 4 Fish- EBF Movies 2 Fish- Ohio Dept. Nat. Res. Perch Drawings (2)	Perch Drawing Quiz Pisces Quiz A) Transition from Invertebrate to Vertebrates
Handout Notes (3) Filmstrip: "Amphibians"- EBF 6 Frog Drawings	Frog Brain Drawing Quiz #1 Frog Urogenital Drawing Quiz #2 Frog Embryology Drawing Quiz #3 Frog Internal Organs Drawing Quiz #4 Frog Muscles Drawing Quiz #5 Frog Skeleton Drawing Quiz #6 Amphibia Test A) Transition from water to land
Handout Notes (2) Filmstrips: (6 EBF) "Crocodilians" "Snakes" "Lizards" 3 Fossil - Reptiles	Reptilia Test A) Emphasize the significance of the egg upon a completely terrestrial life
Handout Notes (3) Filmstrips: 5 Birds Movies (O.D.N.R.) 1 Quail or M. Dove 1 Ducks Bird Drawing (1)	Bird Drawing Quiz Voluntary Bird Test Aves Test A) Stress adaptations or specializations

Course Content	A) Teaching Methods B) Learning Activities
ADVANCED BIOLOGY	
Unit XIV CLASS MAMMAL and ORDER PRIMATES	Lecture Lab: None
Unit XV ANTHROPOLOGY	Lecture Lab: None
Unit XVI HISTOLOGY	Lecture Lab: Cell Slides
Unit XVII BONES	Lecture Lab: Human Skeleton
Unit XVIII MUSCLES	Lecture Lab: None
Unit XIX VITAMINES and MINERALS	Lecture Lab: None
Unit XX DIGESTION	Lecture Lab: Beef Stomach Torso Model

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Handout Notes (2) 1 Mammals 1 Primates Filmstrips (EBF) 6 Mammals Movies (O.D.N.R.) 2 Mammals	13 Orders Quiz Mammal and Primates Test A) Stress effects of arboreal life upon structure
Handout Notes (3) Opaque Projection of Anthropology and Primates Bulletin Board Anthropology Filmstrips (4) "Anthropology"-F.O.M. "Evolution Today"-EBF "Man Inherits The Earth"-"Stone Age People"-EBF	Anthropology Quiz Anthropology Test
Handout (1) Skin Filmstrip by Jergens Lotion Co.	Histology Test
Handout Notes (1) Skull Drawing (1)	Bone Test
"Cell Movement" Filmstrip-F.O.M. Wall Charts - Muscle Handout Notes (4) Head Muscle Drawing (1)	Muscle Test
Handout Notes (1)	Vitamin Test
Handout Notes (0) Demonstration: Digestive Enzymes	Digestion Test

ADVANCED BIOLOGY

Course Content	A) Teaching Methods B) Learning Activities
Unit XXI RESPIRATION and EXCRETION	Lecture Lab: Beef Lung and Kidney
Unit XXII CIRCULATION and BLOOD	Lecture Lab: Beef Heart
Unit XXIII PLAN A: 2nd Semester Biology Projects Plan B: Genetics	
FINAL EXAMS	

Resources A) Printed B) Audio Visual C) People D) Places	Evaluation A) Expected Outcome B) Testing Program
Handout Notes (0) Torso Model Urinary Model	Respiration and Excretion Test
Handout Notes (1) Heart Model "William Harvey" Filmstrip- EBF "Circulatory Control" Filmstrip- FOM	Circulation Test

Course Content	A) Teaching Methods B) Learning Activities
CHEMISTRY	
Unit I- Basis of Chemistry	
A. Science of Chemistry Systems of Measurement Conversion	A. Lecture Discussion Demonstrations B. Lab Check In Graduated Test tube and Specific Gravity
B. Classification of Matter and Its Changes	A. Lecture, Discussion and Demonstrations B. Bunsen Burner and Glass-working Chemical Changes
Unit II- Organization of Chemistry.	
A. Atomic Structure and Electronic Configuration	A. Lecture, Discussion and Demonstrations B. Properties of substances. Formation and decomposition of compounds
B. Periodic Law	A. Lecture, Discussion and Demonstrations B. Prep. and Prop. of Oxygen Combustion and Dust Explosions
Unit III- Chemical Formulas and Equations.	A. Lecture, Discussion, Demonstrations
A. Valence and Chemical Bonds Systematic Naming of Compounds	B. Prep. and Prop. of Hydrogen
B. Formulas and Composition	B. Distillation and Purfication Indicators and Water of Crystallization
C. Chemical Equations 1. Ordinary 2. Oxidation-Reductions	B. Hydrogen and Carbon as reducing agents
D. Equations and Their Weight Relationships	

Resources A) Printed B) Audio Visual C) People D) Places	Evalution A) Expected Outcome B) Testing Program
A. "History of Measurement" Ford Motor Co.	
B. Unfinished Rainbows" Alcoa Aluminum	B. Quizzes Test A. Be efficient in converting and measuring in both the metric and English systems. Show an understanding of matter and it's ability to change chemically.
	B. Test
A. Practice sheets for electron placement B. "Man Discovers the Atom"- EBF "Our Friend the Atom"- EBF "Atomic Orbital Chart"- Cenco "The Atom"- Life "Atom Chart Denoyer-Geppert" B. "Periodic Table" Cenco	B. Quizzes Test A. Show an understanding of the basic structure of the atom and be able to apply this information towards determining the principles that can be extracted from the periodic table. B. Test
A. Practice sheets for ionic valence, formulas, and naming of compounds	B. Quizzes Test
	B. Test
A. Practice sheets for writing and balancing equations	B. Quizzes Test
	B. Test A. Be able to properly write and name formulas. A. Be able to properly write and balance equations.

CHEMISTRY

Course Content	A) Teaching Methods B) Learning Activities
Unit IV- Solutions, Ions, and Equilibria.	A. Lecture, Discussion, Demonstrations
A. Solutions and Crystals	B. Cation Analysis Titrations: Acids vs. Bases $AgNO_3$ vs. NaCl Solubility Curves
B. Ions and Electricity	B. Cation Analysis
C. Acids, Bases, Salts and Oxides	B. Cation Analysis Prep. of Acids and Bases
D. Principles of Chemical Reactions	B. Cation Analysis Electromotive Series
UnitV-Behavior of Gases	A. Lecture, Discussion and Demonstrations.
A. Gas Laws	B. Cation Analysis
B. Molecular Weight and Volume Relationships of Gases	B. Cation Analysis
Unit VI- Carbon and Its Compounds	A. Lecture, Discussion and Demonstrations
A. The Forms of Carbon and Its Oxides	B. Cation Analysis
B. Hydrocarbons	B. Anion Analysis
C. Classes of Organic Compounds	B. Anion Analysis Preparation of soap
Unit VII- Nuclear Chemistry	A. Lecture, Discussion and Demonstrations
A. Natural Radioactivity	B. Anion Analysis Plateaus of GM Counter Absorption of Radiation
B. Artifical Radioactivity Changing Concepts In Science: Aristotle Newton Einstein	B. Anion Analysis

Resources A) Printed B) Audio Visual C) People D) Place	Evaluation A) Expected Outcome B) Testing Program
A. Mimeo sheets on concentrations of solutions	B. Test A) Show an understanding of the principles involved and operation of: preparing solutions, pH meter and titration.
	B. Quiz
B. pH Meter and its use.	B. Test
	B. Test
	B. Test B. Test A) Be able to understand and solve gas law problems.
A. Mimeo sheets for practice in nomenclature, as well as writing formulas from names	B. Quizzes A) Be able to write and identify organic compounds.
A. Practice sheet on writing isomers	B. Test
A. Mimeo Sheets on operation of Geiger- Muller Tube And Counter	
B. "Mystery of Time" Moody Science Institute	B. Quizzes Test
	A) Show an understanding of radioactivity and the operation of the Geiger Muller counter.

CHEMISTRY

Comrse Content	A) Teaching Methods B) Learning Activities
Unit VIII- Families	A. Lecture, Discussion, and Demonstrations
A. Metals and Alkali Metals	B. General Unknown
B. Nitrogen Family	B. General Unknown
C. Oxygen Family	B. General Unknown
D. Halogen Family	B. Prep. and Prop. of Chlorine Prep. and Prop. of Bromine Prep. and Prop. of Iodine

A) Printed
B) Audio Visual
Resources C) People
D) Place

A) Expected Outcome
Evaluation B) Testing Program

B. Test A) Show understanding of
B. Test the preparation and
B. Test properities of the
halogens.
B. Test A) Show the utilization of
the principles and
Exam techniques in determining
unknowns.

Course Content

A. Teaching Methods
B. Learning Activities

PHYSICS

1st Week

Introduction
  Science
  Magic
  Religion
Historical
Purpose of Physics
Methods
3 Levels of thinking
  Facts
  Principles
  Ways of thinking
Quantitative as opposed to qualitative
Relation to Mathematics
Physics & the Universe
Scientific Revolution

Lecture
Discussion in class
Stress importance of native language as a tool for thinking

2nd Week

Astronomy
Historical Physics
1. Stars
   a. motion
   b. constellations
   c. Earth and Sun
2. Distance
3. Time
4. Measurement
   a. distance
   b. time
   c. mass
   d. temperature
5. Dimensions
6. Aristotle
   Ptolemy
   Copernicus
7. Velocity

1. Photographs of Star Trials
2. Photographs of Constellations
3. Experiment with Gnomon
4. Problems
   a. Metric system relative to English system
   b. Dimensional Analysis
5. Handout sheets
6. Demonstration of Stroboscope
7. Graphing
8. Point out common experiences relative to course content

Resources a. Printed b. Audio Visual c. People d. Places	Evaluation a. Expected Outcome b. Testing Program
Paper backs Newspaper articles Study sheets Text	Students are expected to begin to think about science in different light Test over discussion
Paper backs-- "Copernican Revolution"- Thomas Kuhn	A. Students are expected to have a working ability with Metric System. Understand: 1. Time 2. Distance 3. Light Year to small distances B. Test over Metric System and Dimensional Analysis

Course Content

A. Teaching Methods
B. Learning Activities

PHYSICS

3rd to 5th Week

Motion
1. Distance relative to Time
2. Vector & Scalar Quantities
3. Critical View of Vectors
   a.-Same direction
   -opposite right angles
   -Law of Sines
   -Law of Cosines
   -Bearing
4. Galileo--Acceleration
5. Graphing, Acceleration, Velocity
6. Proportionality, Constant

Demonstration of inclined plane
Experiment
Problems

5th to 10th Weeks

Force and Momentum
a. Laws of motion with mass as factor
b. Circular motion-simple harmonic motion
c. Newton's three laws
d. Acceleration as change in direction
e. Newton's universal law of gravitation
   1. Galileo
   2. Tycho Brahe
   3. Kepler
      Three laws of universe
   4. Christian Huygens
   5. Newton
f. Conservation of
   1. Mass
   2. Momentum
g. Significance of mentioned in "e" above

Demonstrations
1.Momentum
2.Force
c.Circular motion
Experiment circular motion
Problems concerned with aspect of force momentum
Experiment
1. Hooks Law
2. Pendulum

Resources a. Printed b. Audio Visual c. People d. Places	Evaluation a. Expected Outcome b. Testing Program
Film - Frames of Reference-Modern Learning Aids Paper backs 1. Physics the Pioneer Science, by Lloyd Taylor 2. The Birth of a New Physics, Bernard Colen 3. Reference- a. History of Mathematics edited by James R. Newman b. Great Books	Students are expected to: 1. Comprehend significance of Galileo's work 2. Understand Laws of motion 3. Solve problems concerning situations involving motion 4. Test on Vectors, Velocity, Acceleration
Paper back-Birth of a New Physics-Bernard Cohen Library references 1. Great Books 2. Physics-Pioneer Science, Lloyd Taylor	Students are expected to resolve problems into specific parts in dealing with physical systems concerning forces and momentum. Solve probelms concerning Force and Momemtum. Test over: 1. Force and Momentum 2. Circular motion 3. Mid-term test over entire material covered to date.

Course Content	A. Teaching Methods B. Learning Activities
PHYSICS	
2nd Ten Weeks 11th Week	
Review every aspect of a. Astronomy b. Motion c. Vectors d. Momentum e. Force	Notes Problems Discussion
Newton	Demonstration: 1. Wind Tunnel & Air Foil 2. Density
Conservation of a. Energy b. Momentum c. Mass	
Introduce Density and Specific Gravity	
Introduce Matter, Solids, Liquids, and Gases	
Archimedes Principle	
Bernoulli's Principle	
12th-13th Week	
Potential and Kinetic Energy	Demonstration
Significance: a. Social b. Historical	Experiment equating E_p & E_k to prove conservation of energy with pendulum, inclined plane, spring & Hooke's Law Problems illustrating E_p & E_k

Resources a. Printed b. Audio Visual c. People d. Places	Evaluation a. Expected Outcome b. Testing Program
Handout sheets	a. Refresh principles stressed during 1st quarter. b. Test on Qualitative Aspects of Matter
Illustrative Material-Magazines	Students are expected to comprehend E_p & E_k Quantitatively and Qualitatively
Handout sheets	Test on E_p & E_k

PHYSICS

Course Content	A. Teaching Methods B. Learning Activities
14th Week	
Heat a. Form of Energy	Demonstration of Air Thermometer
b. Qualitative- 1. temperature	Problems
2. Fahrenheit 3. Celsius	Lecture
4. Kelvin	Demonstration of Expansion of air to deduce absolute temperature scale
Development of Kelvin scale in depth	
15th-16th Week	
Ideal Gas Law and Kinetic Molecular Theory of Gases	Demonstration
Law of: a. Charles	Laboratory experiment on pressure of gas
b. Gay Lussac c. Boyle	Problems
Universal gas constant	
Avagadro's Number Gas Law as Energy Pressure (atmospheric pressure and weather)	

Resources a. Printed b. Audio Visual c. People d. Places	Evaluation a. Expected Outcome b. Testing Program
Handout sheets	Students are expected to understand and comprehend the origins and significance of Temperature Quiz on temperature-conversion and comparison of temperature F & C.
Handout sheets Magazine articles	Students are expected to comprehend significance of Ideal Gas Law applied to chemistry as well as Physics Test over applications of Gas Laws and Gas Constant

Course Content	A. Teaching Methods B. Learning Activities

PHYSICS

17th-18th Week

Course Content	A. Teaching Methods B. Learning Activities
Concept of heat capacity and specific heat	Laboratory-Calorimetry experiment
a. Heat capacity of metal b. Heat of fusion of ice	Problems
Point out: Correlation of energy, Gas Law and Calorimetry	Lecture
Enthropy - defined Enthalpy	
Mechanical equivalent of heat - Joule	
Engines- Carnot Cycle	

19th-20th Week

Course Content	A. Teaching Methods B. Learning Activities
Review entire main stream of physics from Motion to Calorimetry stressing concepts and universal constants from the historical approach. Time also to allow flexibility on more difficult aspects.	Primary-Discussion Secondary-Lecture

Resources a. Printed b. Audio Visual c. People d. Places	Evaluation a. Expected Outcome b. Testing Program
Handout sheet Library References	Students are expected to be experimentally proficient and conceptually aware of heat capacity Test over heat capacity
Handout sheets	Organize development of physics historically and summarize big ideas Semester Final-Comprehensive

Course Content	A. Teaching Methods B. Learning Activities
PHYSICS	
20th-30th Weeks	
Electricity A. Qualitative & Historical 1. Early history a. charge b. electroscope 1. induction 2. conduction B. Quantitatively 1. Fields a. gravitational b. magnetic c. electrical 2. Current-D.C. 3. Unit of charge-the Coulomb 4. Unit of Intensity-intensity 5. Unit of potential difference-volt	Experiment with: 1. electroscope 2. Van Der Graaf generator 3. magnets Problems concerning quantitative aspects of fields and currents and defination of units.
23rd Week	
OHM's Law introduced	Experiment-Electrolysis
The Mole Concept and Avagadro's Number	Problems dealing with Electrochemistry
Electrochemistry	

Resources a. Printed b. Audio Visual c. People d. Places	Evaluation a. Expected Outcome b. Testing Program
Handout sheets	Students are expected to comprehend significance of electricity in daily living Test over Problems
Handout sheets Periodic Table	Test over OHM's Law and Electrolysis

Course Content	A. Teaching Methods B. Learning Activities
PHYSICS	
24th-25th Week	
Consideration of interrelation of chemistry and physics and the role of electricity in both quantitative sciences	Experiment-A.C. Current
Introduction of the Atom	Demonstrations a. motor b. t.v. c. Crooke's tubes
A.C. Current a. Volt b. OHM c. Amphere d. Watt	Experiment with circuits Problems
Common experience with electricity a. motors b. radio c. t.v. d. communication	
26th-27th Week	
RADIANT ENERGY Light & Sound a. waves 1. sound 2. optics a. reflection b. refraction c. diffraction d. mirrors	Experiment-demonstration of sound Experiment with mirrors Problems concerning waves and use of mirrors

Resources a. Printed b. Audio Visual c. People d. Places	Evaluation a. Expected Outcome b. Testing Program
Material from Bell Telephone, General Electric	Students are expected to grasp the importance of electricity both theoretically and practically
Handout sheets	Work problems concerning household current and circuit problems
	Test over household problems and mole concept and communication
Handout sheets	Test over fundamentals of sound and optics

PHYSICS

Course Content	A. Teaching Methods B. Learning Activities
28th-30th Week	
The Atom a. Greek view b. Dalton c. Rutherford d. Bohr e. Einstein	Demonstration 1. Wave Theory of light 2. Crookes tube and electron discharge 3. Bohr's study of hydrogen wave length with diffraction gradient problems
Light-Energy	
Quantum Theory	
Review	
31st Week	
Continuation of Bohr Atom Planck's constant	Demonstration of Photoelectric effect
	Problems
Compare classical Newtonian Physics with "modern" Quantum physics	Lecture
Introduce Photons & Matter	
Photoelectric effect	
Statistical techniques- 1. emphasize 2. increasing 3. importance of mathematics	

Resources a. Printed b. Audio Visual c. People d. Places	Evaluation a. Expected Outcome b. Testing Program
Handout sheets	Students are expected to understand the development of "Modern" science Qualitative test over history of atom and light as energy Quarter test
Handout Sheets Text	Test on qualitative discussion of atom, photoelectric effect

PHYSICS

Course Content	A. Teaching Method B. Learning Activities
32nd Week	
Nucleus of atoms	Lecture
a. composition	
b. changes in composition	Demonstration of radio activity and isotopes
c. N/P ratio	
d. Radiation	
1. Measurement	Problems concerning radiation
a. Curie	
b. Roentgen	
33rd Week	
Particles	Discussion and problems on half-life
Inverse Square Law	
Half life-Isotopes	

Resources a. Printed b. Audio Visual c. People d. Places	Evaluation a. Expected Outcome b. Testing Program
Literature from A.E.C. Handout sheets	Students expected to understand fundamental principles of radiation and its significance in modern application
	Test over Quantitative aspects of N/P radio, radiation and half-life

PHYSICS

Course Content	A. Learning Activities B. Teaching Methods
34th-35th Week	
Review all that has been covered	Lecture
Emphasis on: a. big ideas b. men and their work c. development of modern thought d. relationship to biology, chemistry and significance of mathematics	Class discussion
36th-40th Week	
This period is reserved for flexibility in schedule, special topics for which students have interest	
Demonstration and emphasis on what is currently going on in physics and in space	

Resources a. Printed b. Audio Visual c. People d. Places	Evaluation a. Expected Outcome b. Testing Program
Magazines Literature from industry	Students are expected to begin to realize the what, why, and how the world theyknow is and has developed and hopefully take less of it for granted
	Exam